MONTHLY WEATHER REVIEW,

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(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to March 14th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 138 Signal Service stations and 13 Canadian stations, as telegraphed to this office; 142 monthly journals and 146 monthly means from the former, and 12 monthly means from the latter; reports from 27 Sunset stations; 238 monthly registers from Voluntary Observers; 38 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Service of, Missouri; reliable newspaper extracts; special reports.

Since July 31, 1878, the following stations of the first class have been opened on the dates named:—Des Moines, Iowa, August 1, 1878; Unalashka, Alaska, August, 18, 1878; Stevenson, D. T., September 19, 1878; Madison, Wis., September 29, 1878; Charlotte, N. C., October 6, 1878; Buford, D. T., October 23, 1878; Deadwood, D. T., November 1, 1878; Keogh, M. T., November 18, 1878; Custer, M. T., December 5, 1878; Chattanooga, Tenn., January 8, 1879; Little Rock, Ark., July 1, 1878; Springfield, Ill., July 1, 1879; Pensacola, Fla., October 27, 1879; Cedar Keys, Fla., November 5, 1879; Yates, D. T., November 10, 1879; Helena, M. T., November 10, 1879; Lewiston, Idaho, November 23, 1879; Dayton, Wash. T., December 1, 1879; Elliott, Tex., December 1, 1878; Assiniboine, M. T., December 13, 1879; Missoula, M. T., December 16, 1879; Breakwater, Del., January 29, 1880. The station at Tybee Island, Ga., was closed February 15, 1879, and that at St. Marks, Fla., on October 30, 1879.

BAROMETRIC PRESSURE.

The mean barometric pressure for the month is shown on chart No. II. Compared with the preceding month, the area of 30.20 which extended over the southern portion of the Middle States and northern portion of the South Atlantic States has moved to the southern portion of Georgia, and the line of 30.10 has moved westward over Texas and southward from New England to the central portion of the Middle States. The pressure has changed slightly in the southern portion of the Lake region, while the area of mean low barometer has moved eastward to the northern portion of Lake Superior. In the Northwest the pressure is generally one-tenth of an inch below the average for the month, while at the Rocky Mountain stations it remains near the normal. The most decided change in the distribution of pressure has occured on the Pacific coast; the high area which was apparently west of the coast during January having moved northeast over Oregon replacing the low area of 29.90 by a genepal increase of pressure on the entire coast. Compared with the same month in previous years, the pressure continues above the normal in the Southern, Middle and New England States and it is slightly below the normal in the Ohio valley and thence northward and northwestward.

This Paper is furnished by the Government of the United States, without charge to the Co-operating Observers acting with the Signal Office in the collection of Simultaneous Reports.

Local Barometric Ranges.—These have been least in Florida, southern California, New Mexico, Colorado, Wyoming and western Texas. They have been greatest over the Middle Atlantic States, Upper Lake region, the Upper Mississippi valley and the Northwest. By districts they are as follows: New England, States, 1.22 to 1.60 inch; Middle Atlantic States, 1.26 to 1.72 inch; South Atlantic States, 0.80 to 1.31 inch; Eastern Gulf States, 0.38 to 1.05 inch; Western Gulf States, 0.86 to 1.13 inch; Ohio Valley and Tennessee, 1.04 to 1.40 inch; Lower Lake region, 1.23 to 1.36 inch; Upper Lake region, 1.37 to 1.95 inch; Upper Mississippi valley, 1.30 to 1.80 inch; Red River of the North valley, 1.56 to 1.70 inch; Lower Missouri valley, 1.33 to 1.54 inch; Upper Missouri valley, 0.73 to 1.02 inch; Middle Eastern Rocky Mountain slope, 1.04 to 1.22 inch; Texas, 0.67 to 1.19 inch; Rocky Mountain stations, 0.64 to 0.95 inch; Middle Plateau, 0.86 to 1.10 inch; California, 0.51 to 0.83 inch; Oregon, 1.16 to 1.22 inch; Washington Territory, 1.27 inch.

Areas of High Barometer.—These areas have moved more directly to the east than usual, and in three cases the direction appears to have been changed from the east to the northeast along the Atlantic coast. Eight of these areas have been traced over the districts east of the Rocky Mountains, while three periods of decidedly high pressure occurred on the Pacific coast during the month attended by unusually low temperature.

No. I.—This is a continuation of No. XI of the preceding month, the centre of greatest pressure having moved northward during the night of January 31st, from southern Illinois to the central portion of Minnesota. At the afternoon report the centre of the greatest pressure was near St. Paul and during the succeeding twenty four hours the area moved directly east to New England attended by generally clear and colder weather in all districts north of the Gulf States. On the morning of the 1st the temperature at Eastport was —10°, at Burlington —8° and at Boston —1°.

No. II.—On the morning of the 3rd this area was central near Yankton while reports from all stations west of the Mississippi valley and on the Pacific coast indicate that this entire region was within the limits of an extended area of high barometer, The unusual pressure of 30.74 at Olympia and 30.76 at Portland occurred on the morning of the 3rd, the former being a departure from the normal of +0.91. The barometer continued very high on the Pacific coast as this area moved directly south to Texas on the 3rd preceded by a light "norther" on the west Gulf coast and attended by cold, clear weather in the interior and light rains on the coast. During the 4th and 5th the pressure increased in the Gulf and South Atlantic States, and the centre passed to the east from San Antonio to Montgomery, where it changed direction to the northeast, following the general direction of the coast line immediately in rear of the severe storm traced as No. II on chart No. I.

No. III—appeared on the night of the 6th in the Northwest, attended by cold northerly winds and clear weather and preceded by an area of low barometer charted as No. IV. Morning report of the 7th places the center of this area over Iowa, where the pressure was 30.60, the barometer having risen to 30.50 over the Gulf States and central Mississippi valley, with lower temperature and cold northerly winds in Texas. This area became well defined and moved towards the South Atlantic coast during the 7th attended by generally clear weather in all districts east of the Mississippi. High northwest winds occurred on the Middle Atlantic coast, as the center advanced from the Ohio valley, but as the area passed to the east of the coast, the wind at stations south of Cape May shifted to the northeast, indicating that the center continued north of or near the 40° of lattitude.

No. IV.—The telegraphic reports of the 8th, indicate the advance of of this area from British America north of the Upper Missouri valley, and at midnight of the 8th it was central near Breckenridge, where the barometer was 30.60 and the temperature —18°, the wind had shifted to southerly at Pembina and Fort Garry, but the temperature remained at —20° at the former station and —22° at the latter. This area moved east during the 9th over the track previously given as No. I, and on the morning of the 10th was central near Boston. Light snows were reported in the Lake region and in the northern portions of the Middle States and New England, when the wind shifted to northwest, but clear, cold weather followed with the increasing pressure. High winds were reported on the coast, the maximum velocity at Eastport being NW. 35 miles, at Lewes NE. 34 miles.

No. V.—At midnight of the 17th the barometer was above the normal over the Plateau regions, from the Upper Mississippi valley to the coast of California. The crowding of the isothermal lines to the south indicated the advance of this area, which was apparently central near Yankton. During the 18th, the barometer continued to rise in the Central valleys and in the Gulf States, while the central pressure increased and moved north to Minnesota. A "norther" occurred in the Western Gulf States, the temperature falling to freezing in northern Texas, and the wind reaching a velocity of 44 miles at Indianola. This area continued central near Fort Garry at the morning telegraphic report of the 19th, when the pressure was 30.86 and the temperature —30°. This was the most decided area of the high barometer during the month, and on the 19th all stations east of the Rocky Mountains were apparently within the limits of this disturbance. Northerly to westerly winds prevailed in all districts east of the 100th meridian and the temperature fall to —2° at stations in the northern portions of the Gulf and South Atlantic States. The barometric gradient increased in the western half of this area as the centre moved toward the Atlantic coast, on the 19th and 20th and severe northwesterly gales occurred at stations north of Cape Hatteras, the winds shifting to northeasterly on the North Carolina coast during the 19th. This area passed to the southeast

over the Middle States on the 20th and was last observed as central over the Atlantic about 300 miles east of Norfolk.

No. VI—Although this area has been indicated as central on the morning of the 21st in Indian Territory, the maps of normal barometric variation for the reports immediately preceding, indicate that this area of increased pressure passed east from the Pacific coast over the Southern Plateau districts and New Mexico. During the 21st this area passed to the east over the Gulf States following in the rear of low area No. XI and disappearing to the southeast of Florida on the 22nd.

No. VII.—This area although well defined as to extent and movement was only relatively high, its centre being enclosed by an isbaric line of 30.10, while low areas of 29.50 were central in New England and Minnesota on the 23rd. At the afternoon and midnight reports the centre remained near Cairo, with northerly winds in the Eastern Gulf States, northwesterly winds in the Middle and South Atlantic States, west to northwest winds in the Lower Lake region, southerly winds in the Northwest and Upper Lake region, and east to south winds in the Western Gulf States. The telegraphic reports indicate the anti-cyclonic movement of the wind, and the central pressure of 30.10 shows that this movement may occur when the central area is near or even below the normal pressure. The morning report of the 24th exhibits an extended of high barometer on the Atlantic coast, covering all districts from Florida to the St. Lawrence valley, and at the afternoon reports of the same day the western portion of this area was still observed on the South Atlantic coast.

No. VIII.—Developed slowly in the Southwest on the 28h, while an area of high barometer disappeared north of Minnesota, the depression traced as No. XIV, apparently dividing the two areas of high barometer. On the 29th it moved eastward to the Mississippi valley and was central near Cairo at the close of the month. Rain prevailed in the Gulf States on the 29th, with cold northerly winds and a light "norther" in the Southwest.

Areas of Low Barometer.—Chart No. I exhibits the tracks of the centres of the areas of barometric depression as traced from the regular tri-daily reports. Of the fifteen areas traced, four, Nos. VII, IX, X and XV, passed from the Pacific coast to the Alantic near the northern boundary of the United States. No. II passed northeast from the west Gulf, and all the others were first observed east of the Rocky Mountains and west of the Mississippi river.

No. I.—This area was partly described in January *Review* as No. XVIII, it having passed eastward from Montana to Lake Superior on the 31st accompanied by light snow. On the morning of the 1st, this depression was central near Montreal and severe gales were reported from the Lake region, where the winds had shifted to westerly, with velocities ranging from 20 to 50 miles. This disturbance increased in severity in the south and west quadrants during the day as its centre passed to the east of the coast. The barometric gradient between Portland and Burlington reaching two-tenths of an inch in one hundred miles at 3 p. m. of the 1st. Cautionary Off-shore Signals were ordered and fully justified at the stations on the coast from Cape Henry to Portland, and the Cautionary Signal at Eastport was justified by a velocity of 38 miles. The Signal Service Observer at Albany, N. Y., reports on the 1st "a very high westerly wind which increased to a gale at noon and reached its height at 12:45 p. m., having at that time a velocity of 53 miles per hour. Considerable damage is reported in this vicinity; trees were blown down, houses unroofed and several persons severly injured." The morning report of the 2nd indicated that this depression had continued its easterly course over the Atlantic, followed by colder, clear weather and rapidly rising barometer.

No. II.—This storm is first located in the west Gulf, south of Galveston, at the 11 p. m. report of the 1st, and the previous reports from this region indicate that it developed south of latitude 25° The centre of this depression had passed northeastward to a point near New Orleans on the morning of the 2nd, and the area of rain had extended eastward to the South Atlantic coast, with cold northerly winds, sleet and snow in North Carolina, Tennessee and the northern portion of the Gulf States. The temperature had fallen to 40° at Indianola and the "norther" of the 1st continued with great severity. On the afternoon of the 2nd the centre was near Montgomery, with a well defined elliptical area of 29.60, the longer axis pointing to the northeast in the direstion of the storm's movement. During the eight hours preceding the p. m. report of the 2nd, the following heavy rain-falls were reported: at Mobile, 1.58 inch; Montgomery, 1:31 in; New Orleans, 1.01 in; Vicksburg, 1.07 in; Pensacola, 1.06 in. The barometer continued high in New England, with clear, cold weather and northerly winds during the 2nd, as this depression advanced to the northeast with falling barometer at the centre, thus causing a rapid increase of the barometric gradient in the northeast quadrant. At midnight of the 2nd the centre had advanced to a point near Knoxville; the heavy rains had extended over the South Atlantic States, and snow was falling Virginia, Maryland, Pennsylvania and westward to the Ohio valley. The weather continued clear, with gentle winds or calms on the New England coast, where the pressure was above 30.40, while the pressure at Knoxville was 29.46. As the centre moved to southern Virginia during the morning of the 3rd, the force of wind from the northeast increased on the Middle Atlantic and New England coasts and the snow extended over New England, the Lake region and the Ohio valley The barometer continued to fall at the centre as this depression passed over New England, the afternoon report of the 3rd, giving the pressure of 29.08 at New London, 29.12 at New York, with a north wind, maximum velocity 48 miles; Boston, NE. 60 miles; Thatcher's Island, SE. 88 miles. Snow continued in New England during the 3rd, the wind shifted to the northwest, with rising barometer and clear and cold weather at night, as the depression disappeared to the northeast over Nova Scotia. Cautionary Signals were displayed

in advance of this storm, on the Gulf and Atlantic coasts, and the following reports from the Signal Service Observers have been received: The observer at Mobile reports, "weather, during display of signal, was decidedly threatening and the display was beneficial as it prevented vessels from leaving port." The observer at Pensacola reports, "no vessels left port during display, signals fully justified, maximum velocity 40 miles per hour, no damage of any consequence occurred as the masters of vessels were on the alert." The observer at Smithville, N. C., reports, "Cautionary Signal fully justified, gale set in at 12:30 p. m., and increased until 6:45 p. m., when wind had reached a velocity of 32 miles, NE. The wind lulled at midnight and shifted to southwest with increasing velocity until it reached 32 miles at 3 a. m. Amount of rainfall during gale, 2.35 inches." Delaware Breakwater, on the 3rd, "gale from the northeast, 48 miles, wind shifting to southwest, 58 miles." Observer at Sandy Hook reports this as the severest storm ever known at the station, wind at 7:45 a. m. reached a velocity of 84 miles from the east. The barometer stood at its lowest, 28.91, at 2 p. m. of the 3rd. A number of wrecks occurred, and about two miles of the track of the Southern New Jersey railroad, near Highlands, were washed away. The observer at Boston reports, "heavy snow set in at 4:20 a. m. of the 3rd, with puffs of brisk wind from the east-southeast, it having clouded very suddenly at 2 a. m. The barometer fell rapidly after midnight, being 30.40 at 1 a. m., 30.03 at 7 a. m., 29.70 at 10 a. m., 29.33 at 2 p. m., 29.12 at 4:15 p. m., 29.06 at 5:16 p. m. The wind rose rapidly soon after 5 a. m., and at 11:23 a. m. was E. 56 miles. Velocities taken at five minutes' intervals showed a greater speed, sometimes 66 miles and the squalls and puffs, which characterized the gale, came in velocities of 60 to 90 miles. After 4 p. m. the wind backed gradually to the northeast and at 7 p. m. to northwest. At 6 p. m. the barometer began to rise; the snow ended at 10:15 p. m.; amount of precipitation 1.05 in. or about 10 inches of snow." The observer at Portland reports, "severe snow-storm commenced before daylight and continued until after midnight, accompanied by high winds from the northeast backing to north about 8 p. m." The gale commenced at Eastport about 1:20 of the 3rd, and reached its maximum velocity of 54 miles, NE. at 10:10 p. m. and ended at 3:25 a. m. on the 4th. During the display of the Cautionary Signal one steamer and twenty schooners remained in port." The following reports have been received from vessels near the Atlantic coast during this storm: Schooner *Starlight*, February 2nd and 3rd, off Cape Fear, heavy gale from east veering to south and west, lost 10,000 feet of lumber off deck. Schooner *Samuel Gilman*, on February 3rd, off Fire Island, had terrific gale from east veering to northwest, lasting thirty hours and increasing to hurricane, with high sea—vessel hove to for nine hours and decks swept of everything." Brig *Walter Smith*, February 3rd, 38° 40′ N., 72° 56′ W., heavy gale from NE. to NW., increasing at 2 p. m. to hurricane, lost sail and had deck swept. Brig *Texada*, at Boston, February 6th, from Mayaguez, was 8 days north of Hatteras with strong north gales and high seas, and February 3rd took a heavy gale from NE., lasting 12 hours with high seas. Brig *Minnie Butler*, February 3rd, in Boston Bay, ESE. gale, with thick snow-storm. Schooner *Stephen Harding*, driven ashore two miles south of Sandy Hook, crew saved but vessel probably a total loss. Brig *Alice Tarlton*, February 3rd, 37° N., 71° 30′ W., had a heavy gale from ESE. to WSW., veering to W., lasting 26 hours, with heavy sea and snow-squalls.

No. III—appeared as a slight depression in the Upper Missouri valley at midnight of the 3rd, accompanied by snow and cold northerly winds in the region west of the Upper Mississippi river, and east of the Rocky Mountains. During the 4th the central area moved directly east, and at midnight it was near Lake Superior, the area of snow having extended eastward over the Upper Lake region, and southward over Illinois, Iowa and northern Missouri. Light snow fell in the Lower Lake region during the 5th, and in the northern portions of New England and the Middle States on the night of the 5th, as the area passed to the east with the pressure increasing at the center. The temperature fell to —30° at Pembina and to —31° at Fort Garry, when the wind shifted to the northwest on the 5th, and cold, clearing weather followed rapidly in the northeastern districts of the United States.

No. IV.—A well-marked depression in the Upper Missouri valley which advanced rapidly in a southeastern direction to the northern portion of Iowa, where it was central on the morning of the 6th. The temperature continued below freezing in the regions north of the Gulf States at the a. m. report of the 6th, but increased rapidly in the Ohio valley and Middle States, as the depression moved over the Lake region on the 6th. This area moved directly to the east after reaching the Lake region, accompanied by very light snow, and causing no marked disturbance, the barometric gradient being very slight and the barometer at the center only relatively low. The pressure continued to rise at the center as this area passed over the Atlantic east of New England, and by midnight it had disappeared to the east followed by clear weather in all districts east of the Mississippi river.

No. V—probably advanced from the Pacific coast, but its center was first approximately located north of Montana on the morning of the 7th. This depression moved over the northern districts of the United States during the 7th and 8th, with an average hourly velocity of 60 miles, causing brisk to high winds in the Lake region on the 8th, and on the Middle and East Atlantic coasts on the 9th. Unlike the depression which immediately preceded this, the pressure decreased at the center as it approached the coast. On the morning of the 8th the lowest isobaric line on the chart was 29.90, when the center was near Duluth, and on the morning of the 9th the isobaric line of 29.50 inclosed the center near Chatham. Cautionary Signals were ordered for Grand Haven, Milwaukee and Ludington, and Cautionary Off-shore Signals were ordered at stations on the Atlantic coast between Lewes, Del., and Eastport, and were verified as follows: Milwaukee, 37 miles; Grand Haven, 28 miles; Breakwater, 40 miles; Sandy Hook and Thatcher's Island,

42 miles; Eastport, 36 miles. The area of precipitation extended from the Upper Mississippi valley to the New England coast, but only light snows prevailed with partly cloudy weather.

No. VI.—Generally clear weather continued during the 9th, with the pressure above the normal east of the Mississippi river, and winds slowly shifting to easterly and southerly in advance of this depression, which was central near Fort Shaw in the Upper Missouri valley at 11 p. m. on the 8th. By midnight of the 9th the lowest barometer readings were observed in Minnesota, and on the morning of the 10th this area was well defined in the Upper Lake region. The temperature increased during the 10th, and clear weather continued in the eastern districts, except in the northeastern portion of the United States where light snows prevailed.

No. VII.—Reports from the Pacific coast on the 9th indicated the advance of a disturbance in the north Pacific, and on the morning of the 10th, easterly to southerly winds were reported from San Diego to Portland, with slowly falling barometer. At this report the centre of the disturbance appeared to the west of Washington Territory and at the p. m. telegraphic report of the same day it had moved to the east of Portland. Rain continued on the coast and in the interior from Arizona to Idaho. Snow and cold threatening weather prevailed in the Rocky Mountain regions during the 10th as this depression advanced to the east, the temperature falling below freezing at stations in the interior of California and in the Plateau regions, after the centre had passed to the east. On the morning of the 11th this area was central near Yankton, although the reports from the northern stations showed the barometer to be very low north of Minnesota. The direction of the winds as noted at the stations on the Eastern slope of the Rocky Mountains, and the rapid fall of barometer at all stations in the Mississippi valley including those in the Western Gulf States indicate the advance of an extended trough of low barometer, which would probably include within its area all the districts east of the Rocky Mountains. The centre moved eastward during the 11th, the rain-area including all stations from the Gulf coast northward to Lake Superior, extending over the Lower Lake region by midnight and causing severe gales in the northern districts. At midnight of the 11th the barometer at Duluth read 28.96; at Marquette 28.88 and at Escanaba 28.95, the centre of depression being apparently north of Lake Superior. Very heavy rains occurred in the northern portion of the Gulf States, Tennessee and the Ohio valley, causing a rapid rise in the rivers of these districts. Violent westerly gales continued in the Lake region during the 12th, as the depression moved to the east-northeast over the St. Lawrence valley and New England. A maximum velocity of 42 miles was reported at Milwaukee and 26 miles at Grand Haven. Dangerous southerly winds veering to westerly occurred on the Middle and East Atlantic coasts on the night of the 12th.

No. VIII.—This area probably developed over the southern Plateau region during the night of the 11th, when the barometer was below the normal in Colorado, New Mexico, Arizona and Utah. Cold threatening weather and snow prevailed in these districts on the morning of the 12th, and the barometer continued to fall in the Southwest, with rain extending east over the Lower Mississippi valley and Tennessee. At the afternoon report of the 12th this depression was central near Fort Sill, and southerly gales prevailed on the West Gulf coast, the wind at Indianola reaching a velocity of 48 miles from the southwest. The midnight report of the 12th showed two depressions, one central near Nashville, where the barometer read 29.49, the other central immediately west of Little Rock, Ark. The storm continued during the night with great severity near the centers of the depressions and the area of greatest rain-fall extended northeastward from Texas over Arkansas, Tennessee, Kentucky and the Ohio valley. A tornado occurred at Nashville about 11 p. m. on the 12th, accompanied by thunder and lightning and very heavy rain, and causing great destruction of property. A violent wind and thunder-storm passed over the eastern portion of Lincoln county, Kentucky, late on the night of the 12, blowing down numerous houses. At Louisville the wind averaged 42 miles per hour for several hours blowing from the southwest, and the temperature fell 21° in six hours. The total rain-fall at this station was 3.02 inches. At Frankfort the river rose at the rate of one-foot per hour, flooding the lower portion of the city. On the 13th the Ohio river was reported rising at all stations from Pittsburg to Cairo. The following heavy rain-falls occurred between the 11th and 13th: Austin, Tenn., 6.25 in.; Memphis, 6.14 in.; Nashville, 8.02 in.; Highlands, N. C., 3.15 in. The Tennessee and Cumberland rivers rose rapidly, causing great loss to property. By the morning of the 13th this storm had extended over the Middle States, the lowest isobaric line being 29.60, enclosing the depression and extending from Little Rock to the eastern portion of Pennsylvania. The center was near Cincinnati on the afternoon of the 13th where the two depressions united and afterward moved to the east as a single area, disappearing to the east of the Atlantic coast on the 14th followed by decidedly colder and high northwest winds. A "norther" occurred in Texas immediately after this depression passed east of the Mississippi river.

No. IX.—This is the second storm of the month which approached Signal Service stations from the Pacific and crossed the mountain range to the Missouri valley, pursuing a well defined course over the districts in the eastern portion of the United States. The advance of this depression was indicated by a rapid fall in the barometer accompanied by rain and snow on the night of the 13th in the North Pacific coast region. Rain and snow extended east and south on the 14th and the wind veered to westerly at the northern stations on the Pacific coast. The midnight report from Humboldt, Battleford and Edmonton on the 14th indicated the easterly movement of this depression, and cold northerly winds, with snow prevailed from the stations named southward to the Missouri valley. During the 15th, the storm passed north of the Lake region causing only a slight disturbance within the limits of the Signal Service stations. Generally clear weather prevailed in all districts except on the New England and Middle Atlantic coasts where light snow prevailed,

owing to the approach of a small depression which apparently developed over the Atlantic near the coast during the night of the 14th.

No. X.—The barometer fell rapidly on the Pacific coast during the 14th, as this depression advanced to the eastward, causing snow in Washington Territory and Oregon on the morning of the 15th, when the barometer was lowest west of Olympia, the pressure at that station being 29.61. During the 15th cloudy weather and rain prevailed on the Pacific coast, except in southern California, and the area of snow extended eastward to the Upper Missouri valley. The barometer was below the normal in the districts on the Eastern and Western Slopes of the Rocky Mountains, and by the morning of the 16th, the centre had advanced to the western portion of Dakota, with slowly rising barometer on the Pacific coast, and continued snow in Montana, Idaho, Utah and Wyoming. At the afternoon of the 16th, the barometer was 29.42 at Yankton near the centre of the disturbance, which had become well defined, with a decided gradient to the eastward as far as Michigan, and to the southward as far as Texas. Clear weather and rising temperature were reported from all districts east of the Rocky Mountain Slope, while snow prevailed in the extreme Northwest, and in the Saskatchawan region of British America. The course of this storm changed to the northeast on the 16th, passing over Lake Superior causing high south to west winds over the lakes and followed by very light rain or snow as the wind shifted to westerly, with lower temperature, in the Upper Mississippi valley and thence eastward over the Lake region. The cold northerly winds which followed this depression on the 16th were accompanied by rain in the central valleys and thence eastward to the Atlantic coast, the rain changing to snow and the weather clearing rapidly as the wind shifted. Cautionary Signals were ordered at the lake Stations and on the Atlantic coast north of Wilmington, in advance of this storm. The following dangerous winds were reported: Milwaukee, maximum velocity 42 miles; Grand Haven, 38 miles; Breakwater, Del., 42 miles; Sandy Hook, 44 miles; Boston, 36 miles; Eastport, 32 miles. Westerly gales were reported at Montreal and Quebec on the morning of the 19th, when the centre of depression was northeast of Chatham, and the storm continued over Newfoundland during the 20th.

No. XI first appeared in the western portion of Dakota on the afternoon of the 19th, and advanced directly to the east during the 19th and 20th, causing light snow in the Lake region, the Ohio valley and thence eastward over the Middle and New England States. The pressure at the centre of this depression decreased from 29.90 to 29.50 in the transit from the Northwest to the New England coast. High winds occurred in the Lake region on the 21st, when the storm passed to the east, and southerly gales were reported off the coast of Nova Scotia in advance of its centre.

No. XII.—This slight disturbance followed rapidly in rear of the preceding, between the 21st and 23rd, first appearing on the afternoon of the 21st in British America north of Dakota. On the 22nd the movement to the southeastward over the Lake region was accompanied by very light snow, but as the centre passed over New England the gradient to the west increased rapidly owing to the advance of high area No. VII, and the winds became dangerous after shifting to the northwest on the Middle and East Atlantic coasts. This storm moved directly east, over the Atlantic on the 24th and probably increased in severity, as the barometer continued to fall at the centre while within the limits of observation.

No. XIII.—This area has been traced westward to the Rocky Mountains, and it probably passed from the Pacific north of Washington Territory. Vessels report stormy weather on the North Pacific during the 21st and 22nd. From the morning of the 23rd to the afternoon of the 24th, this depression moved southeastward to the Upper Mississippi valley, attended by decidedly stormy weather throughout the Northwest and lake region. The rain area extended southward to Tennessee and Texas, and as the centre passed over the Lakes, light rains occurred in the Middle and New England States. The winds increased in force as the centre advanced. On the morning of the 25th the weather was threatening on the Atlantic coast, but the afternoon report showed a change of direction in the movement, and the succeeding report showed that this area was moving from Lake Superior northeastward north of the Canadian stations.

No. XIV.—The barometer continued below the normal in the Lower Missouri valley during the 25th and 26th, while cold northerly winds and snow prevailed in the northern portion of the United States west of Lake Superior. This depression remained almost stationary until the 27th, when it moved eastward as a severe storm, the winds being strongest on the west side, where the gradient was very great. Snow prevailed in the Northwest and in the northern portion of the Lake region on the 28th, and rain fell at all stations, except those in the South Atlantic States. After reaching the southern portion of Michigan on the 28th, the centre was retarded, and then moved slightly to the west between the morning and afternoon reports, after which, the movement was rapidly toward the northeast, attended by violent winds from the south and west in the Lake region and on the coast north of North Carolina. A severe "norther" occurred in Texas on the 28th, and the centre of this storm was near Alpena. Maximum velocity of wind reported at Grand Haven, was 48 miles southwest; at Milwaukee, 47 miles west; at Indianola, 54 miles north.

No. XV.—This depression was central off the North Pacific coast at the midnight report of the 28th, when south to east winds, rain and snow prevailed in Oregon and Washington Territory. The barometer at Olympia fell from 30.16 to 29.75 in 8 hours, and at the morning report it had risen to 29.80, indicating that the centre of this depression had passed to the north or east of that station. The midnight report of the 29th indicated the continued advance of this depression to the east.

INTERNATIONAL METEOROLOGY.

Accompanying the present *Review* will be found three International charts, Nos. IV, V, and VI, representing the meteorological conditions over the northern hemisphere and portions of the southern hemisphere.

No. IV indicates the probable course of the principal storm areas over the Atlantic ocean during the month of *January*, 1880, which have been traced from observations made on board about 110 vessels, and which have been collected from various sources or received directly at this office, up to March 5th, 1880. The following is a short description of these areas and of the meteorological conditions existing over the northern portion of the North Atlantic ocean during January, 1880. On the first of the month the area (No. I) of low pressure passed northeastward to the north of Scotland. This area was the same as described in the *Review* for December, as low area No. XIX and was encountered on December 31st by S. S. *Leipzig* in about 47° N., 37° W. (barometer 29.20 inches, or 741.7 mm.) This vessel reports "at 1.30 p. m. a sudden calm, and fifteen minutes later wind NNE., at first in heavy squalls, increasing to hurricane violence, with rapidly increasing northerly sea and heavy hail and snow squalls; towards evening wind and sea decreased, and at 8 p. m. the barometer read 30.22" or 767.6. S. S. *Indiana* reports December 31st, 48 N. 44 W., barometer 29.38 or 746.3, wind NNW, force 9, hard rain. In the Orkneys a gale from the SW. set in on the night of the 1st, changing on the 2nd to W., with heavy snow. Low area No. II passed rapidly southeastward from the neighborhood of Hudson's Bay to Cape Sable during the 31st of December and was described as area No. XX in the *Review* for the month. On January 1st it passed eastward south of Nova Scotia, where it was encountered by S. S. *Hibernian* in 45° N., 58° W., which vessel reported "fresh SE gale, with heavy snow, latter part wind NNE, barometer 29.19 or 741.4. On the 2nd it passed to the north of parallel 50° N, and was quickly followed by area No. III, (No. II of the January *Review*) which passed over Newfoundland on the night of the 3rd, and on the 4th curved to the northeast. This area was, in its turn, quickly followed by No. IV, (No. III of the January *Review*) which passed eastward over Nova Scotia on the early morning of the 5th, and on the 6th was encountered by S. S. *Algeria* in 48° N., 32° W., which vessel reported barometer 29.33 or 745.0, with "wind shifting in a heavy squall from south to west by south." On the 7th this area also curved to the northwards about the 30th meridian and on the 8th, higher pressures, with diminishing westerly gales, prevailed over the western Atlantic, terminating a period of exceedingly stormy weather over this region, which set in about the 21st of December. Stormy weather, with heavy seas, continued over a small area during the 9th, 10th, and 11th, about 50° N. and 20° to 30° W.; Bark *Water Lilly* encountered a "whirlwind" on the 9th about 60 miles south of the Bermudas, and on the night of the 11th heavy rains, resulting in disastrous floods, occurred at the island of St. Kitts, W. I., but elsewhere over the Atlantic only occasional gales were reported during these days. On the 12th, low area No. V (No. VII of the January *Review*) moved off the coast of the United States, and on the 13th passed northeastward between the Bermudas and Nova Scotia, apparently increasing somewhat in energy; on the 14th it moved eastward south of Nova Scotia, and from the 16th to 17th eastward along the 40th parallel, increasing in area, and with easterly to northerly winds over the Atlantic near the parallel of 50. S. S. *Ohio* sailed from Bremerhaven on the 11th, barometer 30.73 or 780.4, and had constantly falling pressure, with easterly or southerly winds until the 17th, when in 39° N., 25° W. the barometer read 29.80 or 756.9, wind SSW. On the 18th, in 37° N., 28° W. the wind, as reported by the *Ohio*, veered to the W, force 6, and the barometer fell to 29.65; on the 19th, same vessel, in 35° N., 32° W., at 7.35 a. m., Washington time, the pressure had fallen to 29.57 or 751.0, and the wind had veered to NW., force 8. Reports have not yet been received from the Azores, but at Funchal, Madeira Islands, the pressure fell rapidly, with southerly winds, from the 16th to the 19th, when it reached 29.67 or 753.6; southerly winds and low but slowly rising pressure prevailed at this station until the 23rd, when the wind changed to N., with rising barometer. S. S. *Hibernian* sailing from 51° N., 35° W., on the 19th, to 52° N., 6° W., on the 24th, had continued easterly winds, varying in strength from force 4 to 7; the pressure on this vessel was about 29.85 or 758.1 from the 19th to the 21st in 52° N., 25° W., after which it rose. On the 18th, area No. VI was central between the coast of the United States and the Bermudas; on the 19th it moved northward as a somewhat severe storm, being encountered by S. S. *Leipzig* in 40° N., 61° W., and by S. S. *Caspian* in 41° N., 67° W., the former vessel reporting SW. winds, force 7, and the latter NNE., force 5. During the night of the 19th this storm passed northward over Newfoundland. No. VII is a continuation of area No. XI of the January *Review*; it probably moved eastward during the 23rd and 24th, attended by cloudy and rainy weather, and followed by northwesterly gales. S. S. *Nederland* reported low pressures and stormy winds on the 28th in 50° N., 22° W., and on the 30th in 47° N., 31° W., and the S. S. *Sarmatian*, on the 29th, in 48° N., 43° W., had barometer 28.89 or 733.8 mm., with WSW. wind, force 8, rain and very heavy sea, but reports as yet to hand are not sufficiently numerous to allow the tracks of these storms being charted.

On this chart will also be found a short track over the Pacific ocean showing the position of a cyclone encountered on the 28th of *November*, 1879, by the U. S. S. *Ranger*. The following are the positions of the vessel on three days (Greenwich dates,) the 27th and 29th being from observation and the 28th by dead reckoning:—27th, in 39° 38′ N., 175° 50′ E; 28th, 38° 33′ N., 176° 38′ E.; 29th, 38° 17′ N., 177° 32′ E. Below is a table of hourly observations from midnight of the 27th to 10 p. m. of the 29th, with the ship's compass course and speed, as copied from the log and from an interesting report of the storm furnished this office by Lt. W. P. Randall, U. S. N., executive officer, U. S. S. Ranger:

Date.	Hours.	Knots.	Courses Steered.	Winds. Direction.	Winds. Force.	Leeway.	Barometer. Height in inches.	Barometer. Thermometer attached.	Temperature. Air, Dry Bulb.	Temperature. Air, Wet Bulb.	Temperature. Water at Surface.	Weather by Symbols.	Clouds by Symbols.	Clear sky in 10ths.	State of Sea.
27th..	Mid.	4.0	N.	ENE.	4, 5	½	29.92	70	58	57	59	bc.	Cir. Cum.	3	S.
28th..	1 a. m.	1.8	SE.	E. x N.	4, 5	½	29.88	71	60	58	59	c. c.	Cum. Nim.	0	M.
	2 a. m.	5.2	SE. ¼ S.	ENE.	6	½	29.85	69	60	58	59	ocd.	Cum. Nim.	0	M.
	3 a. m.	6.0	SE. ¼ S.	ENE.	6	½	29.83	69	59	57	59	ocd.	Cum. Nim.	0	M.
	4 a. m.	5.6	SE. ¼ S.	NE. x E.	6	½	29.79	69	59	57	59	ocd.	Cum. Nim.	0	M.
	5 a. m.	5.6	SE. ¼ S.	ENE.	6, 7	1	29.75	66	59	57	59	ocq	Cum. Nim.	0	M.
	6 a. m.	5.8	SE. x S.	E. x N.	6, 5	1	29.73	66	59	57	59	ocq.	Cum. Nim.	0	M.
	7 a. m.	6.0	SE. x S.	E. x N.	6	1	29.70	69	60	58	59	oc.	Cum. Nim.	0	M.
	8 a. m.	6.4	SSE. ½ E.	E. x N.	6	1	29.71	71	60	58	59	oc.	Cum. Nim.	0	M.
	9 a. m.	5.5	SE. ¼ S.	E. x N.	6	1	29.70	72	61	59	59	oc.	Cum. Nim.	0	M.
	10 a. m.	4.6	SSE. ½ E.	E. x N.	6	1	29.65	70	61	60	59	op.	Cum. Nim.	0	M.
	11 a. m.	4.0	SSE. ½ E.	E. x N.	6	1	29.60	68	62	61	59	od.	Cum. Nim.	0	M.
	Noon.	3.5	SSE.	E. x N.	6	1	29.47	68	61	61	59	od.	Cum. Nim.	0	M.
	1 p. m.	3.0	NW.	E.	5	1	29.44	69	63	62	60	ocqr.	Nim.	0	R.
	2 p. m.	2.0	N. ¾ E.	E.	5	2	29.38	68	62	61	60	ocqr.	Nim.	0	R.
	3 p. m.	1.8	N. x E.	E.	4, 5	2	29.33	67	62	61	60	ocqr.	Nim.	0	R.
	4 p. m.	2.0	NNE.	ESE.	4, 5	2	29.29	66	62	61	60	ocqr.	Nim.	0	R.
	5 p. m.	2.5	NE. x E.	E.	3, 4	2	29.20	68	63	61	60	ocqr.	Nim.	0	L.
	6 p. m.	2.0	NE.	E.	3, 4	1	29.14	68	63	61	60	ocqr.	Nim.	0	L.
	7 p. m.	3.2	N. x E. ½ E.	ESE.	4	½	29.10	68	64	63	60	op.	Nim.	0	L.
	8 p. m.	3.6	NE. x E.	SE. x S.	4	½	29.01	69	65	64	60	op.	Nim.	0	L.
	9 p. m.	4.4	E.	S.	5, 6	½	28.84	69	66	65	60	opq.	Cum. Nim.	0	R.
	10 p. m.	4.0	E.	S. x W.	5, 7	1	28.72	69	64	64	60	opq	Cum. Nim.	0	R.
	11 p. m.	2.5	SE. x E.	SW.	5, 7	1	28.70	66	64	64	60	ocqp.	Cum. Nim.	0	R.
	Mid.	3.8	SE. x E. ½ E.	WSW.	6, 8	1	28.63	68	64	64	60	ocqp.	Cum. Nim.	0	R.
29th..	1 a. m.	3.4	ESE.	WSW.	6, 9	3	28.66	63	60	57	60	ocqp.	Cum. Nim.	0	R.
	2 a. m.	3.0	S. ½ W.	W. x S.	9, 11	8	28.75	62	59	57	60	ocqr.	Cum. Nim.	0	R.
	3 a. m.	3.0	S. ½ W.	W. x S.	9, 11	8	28.85	62	58	56	60	ocqr.	Cum. Nim.	0	R.
	4 a. m.	3.0	S. ½ W.	W. x S.	10, 9	8	29.05	60	58	57	60	ocqp.	Cum. Nim.	0	R.
	5 a. m.	2.5	S. x W.	W. x S.	9	7	29.12	62	58	57	60	bcq.	Cum. Nim.	0	H.
	6 a. m.	2.5	S. x W.	W. x S.	9	6	29.20	63	58	57	60	bcq.	Cum. Nim.	0	H.
	7 a. m.	2.5	S. x W.	W. x S.	9	6	29.30	63	58	57	60	bcq.	Cum. Nim.	0	H.
	8 a. m.	2.0	S. x W.	W. x S.	9	6	29.38	63	58	57	60	bcq.	Cum. Nim.	0	H.
	9 a. m.	2.0	SSW.	W. x N.	6, 9	4	29.44	64	58	57	60	bcqp.	Nim.	0	H.
	10 a. m.	2.0	SSW.	W. x N.	6, 8	4	29.56	64	57	56	60	bcqp.	Nim.	0	H.
	11 a. m.	2.0	SSW.	W. x N.	6, 8	4	29.63	61	57	56	60	bcqp.	Nim.	0	H.
	Noon.	2.0	SSW.	W. x N.	8, 10	4	29.62	59	56	55	60	ocqr.	Nim.	0	H.
	1 p. m.	2.0	SSW.	W. x N.	8, 10	5	29.61	59	56	54	60	ocqr.	Nim.	0	H.
	2 p. m.	2.0	SSW.	W. x N.	8, 10	5	29.65	60	56	53	60	ocqr.	Nim.	0	H.
	3 p. m.	2.0	SSW.	W. x N.	8, 10	5	29.72	60	56	54	60	bcq.	Nim.	3	H.
	4 p. m.	2.0	SSW.	WNW.	8, 10	5	29.72	60	55	53	60	bcq.	Nim.	5	H.
	5 p. m.	2.0	SW. x S.	WNW.	8, 10	6	29.74	59	54	52	59	bcq.	Cum.	3	H.
	6 p. m.	2.0	SW. x S.	WNW.	8, 10	6	29.78	63	53	51	59	bcq.	Cum.	8	H.
	7 p. m.	2.0	SW. x W.	WNW.	7, 8	3	29.78	63	54	51	59	bcq.	Cum.	6	H.
	8 p. m.	2.0	SW. x W.	WNW.	8, 9	3	29.84	63	54	51	59	bcq.	Cum.	6	H.
	9 p. m.	2.4	SW.	WNW.	7, 9	4	29.87	63	53	50	59	bcq.	Clr. Cum. Nim.	4	H.
	10 p. m.	2.2	SW.	W. x N.	6, 9	6	29.92	58	52	50	59	bcpq.	Cir. Cum. Nim.	3	H.

It is remarked that the easterly winds, in advance of the centre of cyclone, were only fresh to strong breezes except heavy squalls (force 7) at 5 a. m., and that as the wind veered to southwesterly it increased to a heavy gale, with very heavy seas, during which the decks were swept and considerable damage done to vessel. S. S. *Lackawanna*, at 7:35 a. m., Washington mean time, of the 29th, was in 34° 38′N., 160° 12′E., and reported barometer 29.65 (aneroid) wind WSW., force 5–6, cloudy, and long sea swell from the WSW.

Chart No. V shows, by isobaric and isothermal lines, the mean pressure and temperature for the month of *July*, 1878, at 7:35 a. m., Washington mean time, as deduced from the International Simultaneous Observations. The barometer observations have been corrected for temperature and reduced to sea-level. For stations lying outside the area included within the lines and for those in the Southern Hemisphere, the means are shown by figures, indicating the temperature in degrees, Fahr., and the pressure in English inches. The paucity of observations over the Pacific ocean is to be regretted, but it has been thought better to draw a few lines, indicating the means of observations received, than to leave the space blank. If these means are considered as fair approximations to the monthly means, the area of highest pressure over the Northern Hemisphere, for this month, will be found covering the greater part of the eastern half of the North Pacific ocean; the maximum readings (about 30.50 inches, or 774.7 m. m.) occurring in the ten degree square, bounded by the parallels 30° and 40° N., and meridians of 140° and 150° W. The prevailing winds over this region show a decided circulation around this centre of elevation, being northwesterly off the American coast; northeasterly, brisk to high, along the 25th parallel westward to the Honolulu Islands, and southerly from the northwestern margin of this high pressure area to Behring Sea. The second area of maximum pressure is found over the North Atlantic ocean, central to the southwest of the Azores, the means at Punta Delgada and Angra, being respectively, 30.32, or 770.1 and 30.31, or 769.9. The low area over the North Atlantic, having continued its journey northward, is central to the north of the extreme stations, viz.: Godthaab and Stykkisholm, where the prevailing winds are southerly. An interesting feature of the distribution of the atmospheric pressure over the North Atlantic during the four months, April, May, June and July, is found in the gradual northward motion of the high and low pressure areas, until the centre of the high pressure of July is found to occupy nearly the same geographical position as the centre of the low area of April. Over western Europe and Asia, excepting the east and south portions of Hindostan, the mean pressure is decidedly lower than during the preceding month of June, with an easterly motion of the central depression. The area of low, which during

the month of June occupied the central northern portion of Hindostan, moved to the eastward, and during July is found over the Province of Scinde, the mean for the latter month exceeding that of the former at all the India stations except Agra, Bombay, Deesa and Kurrachee. The west monsoons and heavy rains which set in along the Bombay coast during June increased throughout July, the rainfalls at the stations Bombay and Poona, for these months, being, respectively, for June, 19.82 and 1.94 inches, and July, 48.24 and 10.53 inches. Along the Bengal coast the southerly monsoons continued to blow throughout the month, while in the upper valley of the Ganges, the Northwestern Provinces, the northwesterly winds of June gave way to the easterly winds of July. Over Siberia and Russia the lowest pressures are found at Kasan and Ekaterinburg, around which stations a decidedly circular motion of the winds is observable.

On chart No. VI are traced the paths of the principal storm areas which traversed the northern hemisphere during the month of *July*, 1878. The general distribution of these tracks agrees with the areas of mean low pressure shown on chart No. V, while their general direction is easterly, inclining towards the northeast over the oceans and towards the southeast over the land areas. The tracks over the Behring sea region and Alaska are based upon tri-daily observations at St. Michael's and St. Paul's Island, and are probably nearly correct, while the succession of meteorological changes occurring at these stations, at those in Washington Territory, and at York Factory, B. A., indicate a connection between some of these areas and those moving eastward over British America.

TEMPERATURE OF THE AIR.

The general distribution of temperature for February, 1880, is shown by the isothermal lines on chart No. II. As in the preceding month the temperature continued above the normal in all districts east of the 100th meridian, and many reports show that it has been the warmest February which has occurred in many years in the eastern districts of the United States. The temperature has fallen at the Rocky Mountain stations and in the districts on the Pacific coast, where it has ranged from 2° to 6° below the normal. An excess of 6°.5 is reported in the Lower Lake region and 6°.2 in the Middle States. In the western portion of the continent, especially in the northern districts, the temperature has been unusually low. The table of comparative temperatures for the several districts is printed on the right side of chart No. II.

The following notes are of interest as indicating the unusually high temperatures of the month in various sections: Houston, Ala., mildest winter for many years, the present month unusually warm. Sandy Springs, Md., month exceptionally warm. Waltham, Mass., mean temperature of the month 5° above the average. Westborough, Mass, remarkably mild month. Fall River, Mass., month unusually warm, no frost in ground. Litchfield, Mich., month very warm, frost entirely out of ground. Brookhaven, Miss., month unusually warm. Grafton, N. H., from the 10th to the 29th month unusually warm, five heavy thaws occurring during that period. Palermo, N. Y., warmest February in past 12 years. Cleveland, Ohio, warmest February in past 25 years, excepting 1857. Snowville, Va., month very warm and dry.

Minimum Temperatures.—Maine: —15° at *Orono and —12° at Eastport. *New Hampshire:* —27° on summit of Mt. Washington and —21° at *Dunbarton. *Vermont:* —22° at *Strafford and —12° at Burlington. *Massachusetts:* —20° at *Billerica, —5° at Boston and —6° at Springfield. *Rhode Island:* 2° at Newport. *Connecticut:* 2° at New Haven and New London. *New York:* —20° at *Schroon Lake, 1° at Buffalo, 2° at Oswego, —7° at *Ithaca, —10° at Albany and 10° at New York city. *Pennsylvania:* —12° at *Wellsboro, 2° at *Catawissa, 10° at Pittsburg and 12° at Philadelphia. *Delaware:* 18° at *Dover. *Maryland:* 0° at *Cumberland, 11° at *Woodstock, *Fallston, *Owing's Mills and *Sandy Springs and 15° at Baltimore. *District of Columbia:* 14° at Washington. *Virginia:* —1° at *Mt. Solon, 18° at Lynchburg and 22° at Norfolk. *West Virginia:* —6° at *Helvetia and 3° at Morgantown. *North Carolina:* 15° at *Franklin and *Highlands, 30° at Wilmington, and 33° at Cape Lookout. *South Carolina:* 36° at Charleston, and 31° at *Aiken. *Georgia:* 25° at *Gainesville and 31° at Atlanta, *Forsyth and *Thomasville. *Florida:* 34° at *Houston, 36° at Pensacola, 52° at Punta Rassa and 64° at Key West. *Alabama:* 28° at *Green Springs and 34° at Mobile. *Mississippi:* 27° at *Fayette and 31° at Vicksburg. *Louisiana:* 22° at *Okaloosha, 29° at Shreveport and 43° at New Orleans. *Texas:* 1° at Ft. Elliott, 10° at Pilot Point, 19° at Ft. McKavett, 24° at Stockton and 37° at Edinburg and Brownsville. *Ohio:* 3° at *Bellefontaine, 19° at Cincinnati and 11° at Columbus, Cleveland and Toledo. *Kentucky:* 12° at *Bowling Green and 22° at Louisville. *Tennessee:* 7° at *Austin, 11° at Nashville, 25° at Memphis, and 28° at Chattanooga. *Arkansas:* 16 at *Mt. Ida and 32° at Little Rock. *Michigan:* —12° at Escanaba, —8 at Alpena and Marquette, 6° at Port Huron, 9° at Grand Haven and 11° at Detroit and *Lansing. *Indiana:* 7° at *New Corydon, 11° at Ft. Wayne, 14° at Indianapolis and 18° at *New Harmony. *Illinois:* —2° at *Geneseo and *Riley, 12° at Chicago, 13° at Springfield and 23° at Cairo. *Missouri:* 2° at *Corning and *Oregon, 7° at *Kansas City and 14° at St. Louis. *Kansas:* —4° at Dodge City, —3° at Ft. Leavenworth, 4° at *Manhattan and 8° at *Lawrence. *Wisconsin:* —20° at *Embarrass, —19° at *Neillsville, —5° at La Crosse and 0° at Madison. *Iowa:* —12° at *Cresco and *Nora Springs, —6° at *Glenwood, 1° at Des Moines, 2° at Dubuque and 9° at Keokuk. *Nebraska:* —23° at *Ft. Sidney, —8° at North Platte and *Ft. McPherson, and 0° at Omaha. *Indian Territory:* 15° at Ft. Gibson and 17° at Ft. Sill. *Minnesota:* —28° at *Breckenridge, —22° at Duluth and —18° at St. Paul. *Dakota:* —35° at Pembina, —23° at Deadwood, and —14° at *Morriston. *Colorado:* —17° at *Ft. Collins, —16° at *Hermosa and —8° at Denver. *New Mexico:* —3 at Santa Fé, 9° at Socorro, 17° at La Mesilla. *Wyoming:* —28° at * Ft. Fred Steele and —10° at Cheyenne. *Utah:* —19° at *Coalville and 3° at St. Lake City. *Nevada:* —26° at *Boca

and 5° at Winnemucca and *Carson City. *Arizona:* —11° at Prescott, —9° at Apache, and 25° at Yuma and Phœnix. *Idaho:* —13° at *Ft. Hall and 11° at Boise City. *Montana:* —28° at Virginia City. *California:* 18° at Campo, 24° at Visalia, 27° at Red Bluff, 35° at San Diego and 38° at San Francisco. *Oregon:* 14° at Umatilla, 20° at Roseburg and 26° at Portland. *Washington Territory:* 25° at Olympia.

Those marked with * are reported by Voluntary Observers or U. S. Army Post Surgeons.

Maximum Temperatures.—Maine: 58° at Portland and 45° at Eastport. *New Hampshire:* 56° at *Grafton and 40° on summit of Mt. Washington. *Vermont:* 56° at *Charlotte and 53° at Burlington. *Massachusetts:* 66° at *Somerset, 64° at Boston and 62° at Springfield. *Rhode Island:* 56° at Newport. *Connecticut:* 65° at New Haven and 62° at New London. *New York:* 66° at *Schroon Lake, 65° at New York city, 57° at Buffalo, 61° at *Ithaca and 58° at Albany. *Pennsylvania:* 72° at Pittsburg, 69° at *Catawissa, and 67° at Philadelphia. *Delaware:* 70° at *Dover. *Maryland:* 68° at *Woodstock and *Cumberland and 67° at Baltimore. *District of Columbia:* 70° at Washington. *Virginia:* 80° at *Johnsontown, 78° at Norfolk and 70° at Lynchburg. *West Virginia:* 71° at Morgantown and 68° at °Helvetia. *North Carolina:* 81° at Wilmington and *Weldon, 67° at Cape Lookout and 65° at *Highlands. *South Carolina:* 78° at *Aiken and Charleston. *Georgia:* 82° at *Thomasville, 81° at Augusta and 80° Savannah. *Florida:* 90° at *Houston, 83° at Key West, 81° at Jacksonville and 79° Punta Rassa. *Alabama:* 79° at and 77° at Mobile. *Mississippi:* 82° at Vicksburg and 79° at *Brookhaven. *Louisiana:* 83° at *Okalooska, 78° at Shreveport and 77° at New Orleans. *Texas:* 91° at Rio Grande, 87° at Concho and Castroville, 82° at Stockton, 78° at Ft. Elliot, and 76° at Denison and Henrietta. *Ohio:* 69° at Bellefontaine and *Wooster, 67° at Cincinnati and 64° at Toledo. *Kentucky:* 69° at Bowling Green and Louisville. *Tennessee:* 78° at Knoxville and 74° at Memphis, *McMinnville and Chattanooga. *Arkansas:* 75° at Little Rock and 72° at *Mt. Ida. *Michigan:* 66° at *Niles, 64° at *Lansing, 60° at Detroit, 58° at Alpena and Grand Haven, 50° at Marquette and 40° at Escanaba. *Indiana:* 69° at *New Corydon and *Logansport, and 65° at Indianapolis, *Spiceland and *New Harmony. *Illinois:* 73° at *Anna, 68° at Cairo, 67° at Springfield and 63° at Chicago. *Missouri:* 72° at *Frankford and *Pierce City, and 71° at Kansas City and St. Louis. *Kansas:* 77° at *Independence, 71° at *Yates Center, 70° at Dodge City and 67° at Leavenworth. *Wisconsin:* 58° at *Beloit, 56° at La Crosse, 55° at Madison and 40° at *Embarrass. *Iowa:* 68° at Des Moines, 67° at Keokuk, 60° at *Glenwood and 59° at Dubuque. *Nebraska:* 68° at Ft. *McPherson, and 66° at *Ft. Sydney, North Platte and Omaha. *Indian Territory:* 79° at Ft. Sill and 75° at Ft. Gibson. *Minnesota:* 59° at St. Paul, 52° at Duluth, and 49° at Breckenridge. *Dakota:* 70° at *Morriston, 55° at Deadwood and 36° at Pembina. *Colorado:* 60° at Ft. *Collins, 59° at Denver and 48° at *Hermosa. *New Mexico:* 74° at La Mesilla, 66° at Socorro and 51° at Santa Fe. *Wyoming:* 59° at Cheyenne and 52° at *Ft. Fred Steele. *Utah:* 45° at Salt Lake City and *Coalville. *Nevada:* 53° at Carson City and 50° at Winnemucca. *Arizona:* 77° at Tucson, 73° at Yuma and 56° at Prescott. *Idaho:* 55° at Ft. Hall and 53° at Boise City. *Montana:* 40° at Virginia City. *California:* 70° at Los Angeles, 69° at Red Bluff, 64° at Sacramento and Visalia, 63° at San Diego and Campo, and 62° at San Francisco. *Oregon:* 53° at Umatilla, 52 at Portland and 51° at Roseburg. *Washington Territory:* 49° at Olympia.

Those marked with a star (*) are reported by Voluntary Observers or U. S. Army Post Surgeons.

Ranges of Temperatures at Signal Service stations.—The *monthly ranges* will appear from an examination of the maxima and minima just given. The greatest *daily ranges* vary in New England from 32° at Thatcher's Island, 35° at New Haven and Newport to 46° on the summit of Mt. Washington. Middle Atlantic States, 24° at Baltimore, Philadelphia and Sandy Hook to 36° at Albany and Norfolk. South Atlantic States, 21° at Cape Lookout, 25° at Jacksonville, Charleston and Atlanta to 32° at Augusta. Eastern Gulf States, 11° at Key West, 19° at New Orleans, 25° at Cedar Keys to 27° at Montgomery. Western Gulf States, 23° at Galveston, 29° at Vicksburg, 31° at Little Rock to 41° at Corsicana. Ohio valley and Tennessee, 26° at Cincinnati and Cairo, 31° at Chattanooga 35° at Pittsburg to 37° at Morgantown. Lower Lake region, 31° at Oswego, Erie and Toledo to 37° at Rochester. Upper Lake region, 25° at Chicago, 32° at Marquette, 38° at Duluth to 42° at Alpena. Upper Mississippi valley, 26° at Dubuque, 36° at St. Paul, 38° at St. Louis to 46° at Keokuk. Red River of the North valley, 45° at Pembina to 47° at Breckenridge. Missouri valley, 32° at Omaha, 44° at Leavenworth to 51° at North Platte. Texas, 33° at Eagle Pass, 45° at Fredricksburg, 41° at Stockton, 40° at Rio Grande City to 64° at Fort Elliott. Eastern Rocky Mountain Slope, 37° at Fort Gibson, 40° at Dodge City to 44° at Fort Sill. Rocky Mountains, 36° at Cheyenne, 40° at Denver to 43° at Santa Fe. Middle Plateau 25° at Salt Lake City to 36° at Winnemucca. California, 21° at San Francisco, 28° at Sacramento, 30° at Red Bluff to 34° ot Los Angeles.

Frost—was reported very generally from all States and Territories north of the 37th parallel. In Florida on the 4th and 16th, and in the remaining States of the Eastern Gulf, 3rd, 4th, 6th, 7th, 9th, 10th, 14th, 15th, 16th, 22nd. Western Gulf States, 1st to 6th, 13th, 14th, 15th, 16th, 18th, 19th, 28th, 29th. At Henrietta, Texas, on the 28th peach blossons reported killed by frost. Indian Territory, 1st, 4th, 5th, 6th, 7th, 9th, 14th, 21st, 23rd. California, 1st to 4th, 6th to 20th, 28th and 29th.

Ice—was reported generally throughout the northern sections of the country, as will be seen by reference to the chapter on Navigation. In North Carolina it formed on the 4th, 5th, 7th, 8th, 16th, 20th, 21st. Tennessee, 2nd, 4th, 5th, 6th, 7th, 15th, 19th, 20th; Memphis, 3rd, Gayoso Bayou frozen over. Texas, 4th, 5th, 6th, 7th, 19th, 28th, 29th. California, San Francisco, 11th, 16th, 17th, 19th, 20th.

Ground Frozen.—San Francisco, 16th; Pilot Point, Tex., 28th, 1 in.; Cairo, Ill., 29th; Melissa, Tex., 4th, 5th, 6th, 7th, 28th, 29th.

PRECIPITATION.

The general distribution of the rain-fall, including melted snow, for the month, is illustrated upon chart No. III, as accurately as possible from about 500 reports. This chart shows the area of maximum precipitation over western Tennessee, and areas of minimum precipitation over the Eastern Slope of the Rocky Mountains and in the Red river of the North valley. In the left-hand corner of the same chart will be found a table of average rain-falls for the month of February, which shows large excesses for the present month over the region of heaviest rain-fall and in the St. Lawrence valley. An excess of about one inch is also found in the Lake region and Florida. In the Middle and South Atlantic and Eastern Gulf States and to the west of the Mississippi valley, deficiencies occur, which are found to be largest on the Pacific coast.

Special Heavy Rains.—1st, New Ulm, Tex., 2.06 in.; San Antonio, Tex., 2.05 in. 1st and 2nd, Mesquite, Tex., 5.00 in; Melissa, Tex., 2.90 in., Brookhaven, Miss., 2.50 in.; Shreveport, La, 3.30 in.; White Plains, N. Y., 3.85 in.; Fort Barrancas, Fla, 2.61 in. 2nd, Mobile, 2.80 in. 2nd and 3rd, Cape Lookout, N. C., 2.91 in.; 3rd, Penn Yan, N. Y., 2.86 in. 9th, Mayport, Fla., 3.11 in. 11th to 13th, Austin, Tenn., 6.25 in.; Memphis, Tenn., 6.14 in.; Nashville, Tenn., 8.02 in.; Laconia, Ind., 3.34 in.; Highlands, N. C., 3.15 in 13th, Helvetia, W. Va., 2.09 in. in 30 hours. 19th, Santa Barbara, Cal., 9.93 inches in 46 hours. 19th and 20th, Lompoc, Cal., 4.40 in. 27th, Melissa, Tex., 3.00.; Clarksville, Tex., 3.75 in. 27th and 28th, Little Rock, Ark., 5.24 in.; Mount Ida, Ark., 3.00 in. 28th and 29th, Mesquite, Tex., 5.00 in.; New Ulm, Tex., 2.44 in.

Largest Monthly Rainfalls, including Melted Snow.—Nashville, Tenn., 12.37 inches; Mesquite Tex., 10.75 in.; Austin, Tenn., 9.89 in.; Memphis, 9.44 in.; Little Rock, Ark., 7.95 in.; McMinnville, Tenn., 7.65 in.; New Ulm, Tex., and College Hill, Ohio, 7.50 in.; Cedar Keys, Fla., 7.35 in.; Cape Hatteras, N. C., and White Plains, N. Y., 7.13 in.; St. Augustine, Fla., 6.91 in.; Brookhaven, Miss., 6.50 in.; Melissa, Tex., 6.40 in.; Mayport, Fla., 6.39 in.; Laconia, Ind., and Shreveport, La., 6.19 in.; Lompoc, Cal., 6.18 in., Jacksonville, 6.17 in.; Montgomery, 6.11 in.; Ashwood, Tenn., 6.10 in.; Clarksville, Tex., 6.00 in.; Ft. Barrancas, Fla., 5.78 in.; Cape Lookout, N. C., 5.77 in.; Mobile, 5.73 in.; Mt. Ida, Ark., 5.70 in.; Portland, Or., 5.67 in.; Highlands, N. C., and Margaretta, Ohio, 5.55 in.

Smallest Monthly Rain-falls, including Melted Snow.—India, Cal., Ft. Lyon, Col., Stockton, Texas and Breckenridge, none; Ft. Wallace and Dodge City, Kan., Ft. McPherson, Nebr., Yuma, Ariz., and El Paso, Tex., trace; Pilot Point, Tex., 0.01 in.; Ft. Hartsuff, Nebr., 0.02 in.; Socorro, N. M. and North Platte, 0.03 in.; Ft. Elliott, Tex., and Manhattan, Kan., 0.05 in.; Cheyenne, W. T., 0.09 in.; De Soto and Howard, Nebr., and Ft. Verde, Ariz., 0.13 in.; Ft. Sidney and Omaha, Nebr., 0.14 in.; Vail, Ia., and Tucson Ariz., 0.15 in.; Prescott, Ariz., 0.26 in.; Des Moines, Ia., 0.17 in.; Glenwood, Ia., and Plattsmouth, Nebr., 0.18 in.; Pembina, Dak., 0.20 in.; Wickenburg, Ariz., 0.25 in.; Ft. Garland and Denver, Col., 0.32 in.; Corning, Mo., 0.35 in.; Ft. Fred Steele, W. T., and Phoenix, Ariz., 0.38 in.; Nora Springs, Ia., 0.40 in.; Camp Sheridan, Nebr., 0.42 in.; Lawrence and Wellington, Kan., and La Mesilla, N. M., 0.43 in.; Camp Grant, Ariz., 0.48 in.; Florence, Ariz., 0.49 in.; Genoa, Nebr., and Holton, Kan., 0.50 in.

Rainy Days.—The number of days on which rain or snow has fallen, varies as follows: New England, 12 to 23; Middle Atlantic States, 6 to 13; South Atlantic States, 7 to 12; Eastern Gulf States, 4 to 13; Western Gulf States, 8 to 16; Lower Lake region, 15 to 25; Upper Lake region, 8 to 20; Ohio valley and Tennessee, 9 to 17; Upper Mississippi valley, 7 to 11; Missouri valley, 2 to 5; Red River of the North valley, 0 to 9; Eastern Rocky Mountain Slope, 1 to 12; Texas, 1 to 16; Rocky Mountains, 2 to 7; Middle Plateau, 9 to 13; California, 8 to 10; Oregon, 14 to 18.

Cloudy Days.—The number varies in New England from 5 to 16; Middle Atlantic States, 5 to 12; South Atlantic States, 4 to 13; Eastern Gulf States, 3 to 15; Western Gulf States, 10 to 20; Lower Lake region, 9 to 16; Upper Lake region, 11 to 15; Ohio valley and Tennessee, 8 to 13; Upper Mississippi valley, 1 to 8; Missouri valley, 2 to 4; Red River of the North valley, 6 to 9; Eastern Rocky Mountain Slope, 4 to 7; Texas, 0 to 19; Rocky Mountains, 3 to 7; Middle Plateau, 9 to 12; California, 5 to 9.

Hail was reported from the various stations as follows: Lompoc, Cal., 22nd; Elmira, Ill., 24th; Mt. Sterling, Ill., 20th; Ft. Madison, Ia., 24th; Yates Centre, Kan., 18th; Kansas City, Mo., 25th; Ashley, Mo., 20th, 28th; Fort Sill, Ind. Ty., 12th; Henrietta, Tex., 28th; Coleman and Fort Concho, Tex., 1st; Denison, Tex., 12th; La Crosse, Wis., 28th; Duluth, 11th.

Snow fell on the following dates in the various districts:—New England, 1st to 17th, 19th, 21st to 24th; Middle Atlantic States, 1st, 2nd, 3rd, 4th, 5th, 7th, 8th, 9th, 10th, 11th, 13th, 14th, 15th, 18th, 19th, 21st, 23rd; North Carolina, 2nd, 3rd, 6th, 20th, 21st; Georgia, 2nd, 5th, 6th, at Gainesville snow fell to the depth of two inches on the 2nd; Lower Lake region, 1st to 10th, 13th to 16th, 18th to 23rd, 29th; Upper Lake region, 1st to 16th, 18th to 29th; Ohio valley, 1st to 7th, 9th, 13th, 14th, 15th, 18th 19th to 23rd 29th; Tennessee, 2nd, 3rd; Mississippi, Louisiana and Arkansas. 2nd; Upper Mississippi valley, 1st to 7th, 13th, 14th, 17th, 18th, 20th, 25th, 26th, 28th, 29th; Texas and Indian Territory, 1st, 2nd, 3rd, 4th, 12th, 13th, 14th, 29th. Missouri valley, 1st, 2nd, 3rd, 4th, 6th, 7th, 8th, 9th, 11th, 12th, 13th, 15th, 16th 22nd, 24th to 28th. Rocky Mountains, 1st to 6th, 10th, 11th to 19th 22nd to 29th. Middle Plateau, 2nd, 3rd, 9th, 10th, 11th, 13th, 15th, 16th, 18th, 19th, 21st to 29th. California, 11th, snow on summit of Mt. Diablo and along the Coast Range southeast of San Francisco; 22nd, snow storm prevailed on summit of San

Pablo; 23rd, snow on Coast Range. Oregon, 10th, 14th to 19th. Washington Territory, 12th, 13th, 14th, 16th, 17th, 18th.

Largest Monthly Snow-falls.—Emigrant Gap, Cal., 98.75 inches; Summit, Cal., 75.00 in.; Cisco, Cal., 71.00 in.; Alta, Cal., 49.00 in.; Colfax, Cal., 48.00 in.; Truckee, Nev., 46.50 in.; Surry, Me., 34.00 in.; Boca, Nev., 30.00 in.; Little Mountain, Ohio, 29.50 in.; Ogden, Utah, 25.50 in.; Palermo, N. Y., 25.00 in.; Coalville, Utah, 24.50 in.; Lunenburg, Vt., and Penn Yan, N. Y., 23.50 in.; Nile, N. Y. and Newport, Vt., 23.00 in.; Mt. Washington, 21.60 in.; Cleveland, Ohio, 21.50 in.; New Corydon, Ind., 20.10 in.; Cornish, Me., and Stafford, Vt., 20.00 in.; Grafton, N. H., 19.50 in.; Rowe, Mass., 19.00 in.; Lima, N. Y., 18.50 in.; Clinton, Mass., 18.00 in.; Gardiner, Me., 17.75 in.; Woodstock, Vt., 16.70 in.; Norwalk, Ohio, 16.58 in.; Orono, Me., 16.50 in.; Helvetia, W. Va., 16.25 in.; Dunbarton, N. H., and Carson City, Nev., 16.00 in.; Duluth, Mich., 15.50 in.; Waterburg, N. Y., 15.40 in.; Hermosa, Col., 15.30 in.; Auburn, N. H., and Alpena, Mich., 15.00 in.; Amherst, Mass., and Litchfield, Pa., 14.50 in.; Westborough, Mass., 14.00 in.; Antrim N. H., 13.50 in.; Paterson, N. J., 13.25 in.; Hudson, Ohio, New Bedford, Mass., and Tehachapi, Cal., 13.00 in.; Ithaca, N. Y., 12.60 in.; Starkey, N. Y., 12.50 in.; Ruggles, Ohio, 12.00 in.; Wellsboro, Pa., 11.80 in.; Waltham, Mass., 11.50 in.; Northport, Mich., 11.30 in.; Lewisburg, Ohio, 11.30 in.; Ft. Collins, Col., 10.50 in.; Morriston, Dak., Minneapolis, Minn., New Castle, and Dyberry, Pa., Embarrass, Wis., Ardenia, White Plains and Hector, N. Y., and Keene, Cal., 10.00 in.

Snow from a cloudless sky.—Colorado Springs, 4th; Coleman, Tex., 14th; Detroit, Mich., 7th; Springfield, Mass. 5th; Starkey, N. Y., 19th.

The depth of snow on ground at end of month was reported as follows: In Maine, trace to 6 inches; New Hampshire, 0 to 12 in.; Vermont, 2 to 6 in.; Massachusetts, New York and Pennsylvania, trace; lower Michigan, trace to 1 in.; upper Michigan, 2 to 12 in.; Wisconsin, trace to 4 in.; Minnesota, 2 to 6 in.; Iowa, ½ to 2½ in.; Nebraska, trace to 2 in.; Dakota, 1 to 10 in; Colorado, 1 to 20 in. at Hermosa; Wyoming Territory, trace to 3 in.; Montana, 1 inch at Virginia City; Utah, ½ to 6 in.; Nevada, trace at Winnemucca

Floods.—Mesquite, Tex., 28th and 29th, heavy rain-storm, fields badly washed, corn-fields considerably damaged. New Orleans, 2nd, high water broke the levee seven miles below the city; 7th, another break from 150 to 200 feet wide was reported at Kennerville, La. Louisville, 17th, river rose rapidly, flooding the lower floor of houses on Seventh and Water streets. Memphis, 11th, 12th, very heavy rain-storm, cellars flooded gas extinguished and eight bridges across Gayoso Bayou injured or destroyed; city sewers and crossings badly injured; Wolfe river rose rapidly carrying away $5,400 worth of logs; all trains on roads leading into the city were delayed. Albany, N. Y., 14th, sudden rise in the river, flooding cellars on Quay street, also at foot of Broadway and Maiden Lane, causing considerable damage.

Precipitation during January, received after issue of January Review.—Arizona: Whipple Barracks, 0.41 inches; Ft. Lowell, 0.62; Ft. Verde, 1.08; Ft. Apache, 1.24; Ft. Grant, 0.65. *California:* Benicia Barracks, 1.32; Angel Islands, 2.56; Ft. Yuma, trace; Ft. Gaston, 8.45; Ft. Bidwell, 3.10; Oakland, 1.71; Poway, 1.13; San Gorgonia, 1.78; San Buenaventura, 1.41; Campo, 3.00. *Dakota:* Ft. Sisseton, 0.30; Ft. Sully, 0.00; Ft. Totten, 0.40; Ft. Meade, 0.38. *Idaho:* Ft. Lapwai, 0.92; Ft. Cœur d'Alene, 3.74; Lewiston, 0.34. *Michigan:* Ft. Brady, 2.40; Petoskey, 1.53; Ypsilanti, 2.05. *Montana:* Ft. Benton, 024; Ft. Shaw, 0.10; Ft. Ellis, 0.87; Ft. Keogh, 0.14; Ft. Logan, 0.15; Ft. Assinniboine, 0.10; Blackfeet Agency, 0.48. *Oregon:* Ft. Stevens, 28.94; Ft. Klamath, 2.34; Ft. Harney, 0.56; Eola, 7.92; Albany, 11.19. *Texas:* Ft. Ringgold, 0.22; Ft. Brown, 3.13; Ft. Davis, 1.68; Coleman, 2.03; Edinburgh, 1.48; Brownsville, 3.87. *Washington Territory:* Ft. Colville, 2.07; Fi. Canby, 22.28; Ft. Townsend, 3.40; Neah Bay, 25.70; Bainbridge Island, 17.62; Dayton, 3.37. *Florida:* Biscayne, 3.80; Okahumpka, 4.25; Daytona, 3.68; Orlando, 6.01. *Massachusetts:* New Bedford, 1.86; Williamstown, 3.39. *Missouri:* Oregon, 1.59. *New Jersey:* Dodge Mine, 2.36; Deckertown, 1.94. *New York:* Port Jervis, 2.65. *Nevada:* Carson City, 1.00. *North Carolina:* Sulphur Springs, 2.00. *Minnesota:* Breckenridge, 0.01.

RELATIVE HUMIDITY.

The percentages of mean relative humidity for the month range as follows: New England, 68 to 75; Middle Atlantic States, 60 to 77; South Atlantic States, 58 to 80; Eastern Gulf States, 68 to 79; Western Gulf States, 62 to 78; Ohio valley and Tennessee, 60 to 71; Lower Lake region, 68 to 75; Upper Lake region, 62 to 77; Upper Mississippi valley, 59 to 71; Missouri valley, 48 to 63; Red River of the North valley, 90 to 95; Eastern Rocky Mountain Slopes, 48 to 56; Texas, 26 at Stockton to 79 at Edinburg; Western Plateau, 36 at Yuma to 69 at Boise City; California, 58 to 72; Oregon, 79 to 83. *High stations* report the following averages not corrected for altitude: Virginia City, 57; Cheyenne and Denver, 51; Santa Fe, 47; Mt. Washington, 87.

WINDS.

The *prevailing directions of the wind* are shown by arrows flying with the wind, on chart No. II. On the coast of North Carolina, in Florida and thence along the Gulf coast to New Orleans they are *northeasterly*, but elsewhere south and east of Nebraska, Iowa and Wisconsin, they are *southerly* inclining to *westerly* in the Lake region and along the East and Middle Atlantic coasts. Along the south coast of New England, at Baltimore, Augusta, Atlanta, and from Nebraska northward, they are *northwesterly*.

Total Movements of the Air.—The following are the *largest* total movements recorded in miles at the Signal Service stations during the month: Delaware Breakwater, 13,730 miles; Cape May, 13,029; Wood's Holl, Mass., 12,987; Sandy Hook, 12,276; Thatcher's Island, Mass., 11,929; Cape Lookout, N. C., 10,668; Kittyhawk, N. C., 10,664; North Platte, 10,620; Cape Henry, 10,443; Indianola, Tex., 10,264; Breckenridge, Minn., 10,354; Barnegat, N. J., 10,134; Milwaukee, 9,965; Cheyenne, 9,894; Grand Haven, 9,793; Cape Hatteras, 9,757; Port Huron, 9,258; Erie, 9,069; Newport, 8,893. The *smallest* are: Stockton, Tex., 1,259 miles; Roseburg, Oregon, 2,055; Nashville, 2,105; Visalia, Cal., 2,151; La Mesilla, N. M., 2,181; Uvalde, Tex., 2,411; Santa Fé, 2,608; Deadwood, Dak., 2,634; Lynchburg, Va., 2,695; Augusta, Ga., 2,770; San Antonio, Tex., 3,343; Salt Lake City, 3,392; Portland, Or., 3,451; Olympia, Wash. Ter., 3,458; Silver City, N. M., 3,562; Boise City, Idaho, 3,602; Los Angeles, Cal., 3,700.

Local Storms.—Pilot Point, Tex., 24th, very severe wind storm, attaining a velocity of W. 59 miles, causing considerable damage to trees and fencing. Cincinnati, 18th, severe whirlwind of small diameter passed near the southern railway bridge, destroying considerable property. Nashville, 12th, during the progress of the heavy wind and rain storm, between the hours of 10 and 11 p. m., two small tornadoes were formed within the limits of the city; passing over it from SW. to NE., causing a large of destruction to property. The average width between the paths of the two storms was 1½ miles, and over the central portion for a constant width of a ½ mile no damage was done. The northern tornado commenced its work of destruction at a point about two miles southwest of the signal office, and passed to the northeast a distance of three or four miles, where all trace of the whirlwind's action disappeared. Property to the value of about $30,000 was all destroyed in its path. Trees from 1½ to 2 feet in diameter were uprooted or twisted off, and the debris carried in the direction of the whirl, which was from right to left. The southern tornado descended near Hillsboro Pike, where a small barn was first demolished, it then rose, passing entirely over several houses without injury, reaching the earth again in a short interval it moved to the Custom House, which it damaged to the amount of $8,000; heavy blocks of stone weighing several tons were thrown from the walls, and the whole of one side torn down. After unroofing several buildings and destroying the spire of St. Pauls church the whirlwind disappeared. In the tracks of both tornadoes, the peculiar bounding action of the whirling cloud was easily discernable.

Sand Storms.—Umatilla, Or., 12th, 14th; Stockton, Tex., 12th, 24th; Ft. Garland, Col., 16th, 17th.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily indications for February, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 88.0 per cent. The percentages for the four elements are: Weather, 90.0; Direction of the Wind, 86.3; Temperature, 88.2; Barometer, 87.5 per cent. By geographical districts they are: for New England, 88 3; Middle States, 92.2; South Atlantic States, 86.7; Eastern Gulf States, 88.8; Western Gulf States, 87.9; Lower Lake region, 90.2; Upper Lake region, 88.7; Tennessee and the Ohio valley, 87.2; Upper Mississippi valley, 84.0; Lower Missouri valley, 85.3; Northern Pacific region, 92.6; Central Pacific coast region, 93.1; Southern Pacific coast region, 92.9. There were 10 omissions to predict out of 3,567, or 0.28 per cent. Of the 3,557 predictions that have been made, 139, or 3.65 per cent, are considered to have entirely failed; 89, or 2.50 per cent, were one-fourth verified; 385, or 10.83 per cent, were one-half verified; 145, or 4.08 per cent, were three-fourths verified; 2,808, or 78.94 per cent, were fully verified, so far as can be ascertained from the tri-daily weather maps.

Cautionary Signals.—166 Cautionary Signals were displayed during the month, of which 156, or 94.0 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station. 107 Off-shore Signals were displayed, of which 98, or 91.6 per cent, were fully justified; 106, or 99.1 per cent, were justified as to direction; 98, or 91.6 per cent as to velocity; and 1, or 0.9 per cent, were not justified either as to direction or velocity. 65 of the Off-shore were changed from Cautionary. 273 Signals of both kinds were displayed, of which 254, or 93.0 per cent, were fully justified. The above does not include signals ordered for 50 display stations, where the velocity is only estimated. 51 cases of winds of 25 miles and over per hour, from scattering stations, were reported, and for which signals had not been ordered.

NAVIGATION.

In the table on the right-hand side of chart No. III are given the highest and lowest readings of the Signal Service river-gauges for the month, with the dates of the same. The *Missouri* remained frozen over at Yankton until the 24th, when observations were resumed; at Omaha and Leavenworth the variation in the height of water has not exceeded 4 feet during the whole month. The *Mississippi* continued frozen at St. Paul and La Crosse throughout the month; thence southward to St. Louis the range at any station did not reach 4 feet for the entire month, at Cairo the river fell slowly from the 1st to the 11th; on the 13th it commenced to rise rapidly, and by the 24th had risen to 43 ft. 5 in., or 3 fet. 5 in. above the danger-line, after which it fell slowly to the end of the month, reaching 41 ft. 10 in. on the 29th; at Memphis it fell slowly from the 1st to 12th, after which it rose to the end of the month, when it was within 8 in. of danger-line; at Vicksburg it was within 1 ft. of danger-line (41 ft.) on the 1st, but continued slowly falling until the 17th, when it reached 27 ft. 3 in.; on the 18th it commenced rising, and at the end of the month

had reached 38 ft. 8 in; at New Orleans it fell slowly from the beginning of the month to the 19th, after which it rose to end of month, when it was within 9 inches of danger-line. The *Ohio* at Pittsburg fell slowly from the 1st to the 10th; on the 12th it commenced to rise rapidly, and on the 14th reached 21 ft. 7 in., or 19 inches above danger-line, after which it fell slowly until the 26th, and remained low to end of month; at Cincinnati it fell slowly from the 1st to the 11th; on the 12th a rapid rise set in which continued to the 7th, when the water reached 53 ft. 3 in., or 39 inches above danger-line; it then fell slowly to end of month; at Louisville it remained almost stationary until the 14th, when a rapid rise set in, which on the 18th and 19th reached 30 ft. 6 in., or 6 ft. 6 in. above the danger-line, after which it fell rapidly to end of month. The *Tennessee* at Chattanooga continued low and almost stationary until the 14th, rose rapidly to the 17th, fell to 6 ft. on the 26th and rose slightly to end of month. The *Cumberland* at Nashville rose from the 1st to the 7th to 14 ft. 2 in., fell to the 11th to 10 ft. 4 in., after which it rose rapidly, and on the 19th and 20th reached 44 ft. 2 in., or 26 in. above danger-line, whence it fell to 14 ft. 10 in. on the 26th, and rose to 32 ft. 4 in. by end of month. The *Savannah* at Augusta rose 11 ft. on the 3rd, fell 11 ft. by the 9th, and remained almost stationary to end of month. On the *Red River* at Shreveport navigation has continued without interruption throughout the month, the river continuing to rise slowly from the 14th to the 29th; on the 15th the zero of river-gauge at this station was lowered 3 ft. 6 in, to correspond with the low water of 1879, but the readings given in the table for the present month are above the zero of 1878.

Ice in Rivers and Harbors.—The following notes respecting ice in rivers, &c., are of interest: *Columbia river.*—Umatilla, Or., 1st, 2nd, floating ice in river. *Missouri.*—Plattsmouth, Nev., 16th, ice broken up; 29th, ice gorge broke away from east half of pile bridge, and during the night river froze over the third time this month; Leavenworth, floating ice 1st to 7th, clear of ice 8th, floating ice 21st. *Mississippi.*—St. Paul, river frozen over throughout the month. La Crosse, 9th, ice firm, crossing very good; 27th, ice getting thin, many large open places obstructing all travel. Davenport, floating ice 2nd, 4th to 10th, 13th, 14th, 18th to 22nd, 29th. Keokuk, heavy floating ice 1st to 10th, small quantities of ice 11th; 12th, ice breaking up along Illinois shore; 13th to 16th, heavy floating ice; 17th, river free; 19th, 29th, small quantities of ice; 20th to 23rd, heavy ice; 24th, river clear. Burlington, river full of floating ice 1st to 11th, 13th, 14th, 15th, 20th, 21st, 22nd; clear of ice 12th, 16th, 23rd. St. Louis, light floating ice 4th, 5th, 6th. *Rock River.*—Rockford, Ill., 17th, free of ice; 19th, small quantities of floating ice; 20th, river partly covered with thin ice; 21st, frozen over; 23rd, small quantities of floating ice; 24th, river clear. *Ohio.*—Wellsburg, W. Va., 5th, first ice in the river at this point this winter. *Monongahela.*—Morgantown, 5th, frozen over; 10th, ice breaking up; Pittsburg, 8th, floating ice. *Alleghany.*—Pittsburg, 8th, floating ice. *Susquehanna.*—Litchfield, Pa., 26th, river entirely clear of ice. *Delaware.*—Port Jervis, N. Y., 14th, floating ice; Philadelphia, 10th, ice formed in river during night. *Hudson.*—Albany, 16th, floating ice; 18th, nearly free of ice; 24th and 25th, full of floating ice; Ardenia, 28th, river entirely clear of ice, vessels moving. *Connecticut.*—Springfield, Mass., river free of ice throughout the month. *Lake Superior.*—Duluth, harbor frozen over 1st to 29th. Marquette, harbor covered with ice throughout the month. *Lake Michigan.*—Chicago, 1st, lake frozen; 2nd, ice breaking up; 4th, lake frozen; 10th, lake clear. *Grand River.*—Grand Haven, Mich., river frozen over or full of slush ice from 1st to 21st. *Lake Huron.*—Port Huron, 4th, ice-bridge formed across the bay from Ft. Gratiot Light House to Point Edwards; 9th, ice bridge broke to-day. *St. Clair River.*—Port Huron, 4th, clear of ice; 9th, 19th, floating ice. *Lake Erie.*—Cleveland, 5th, shore ice forming around the piers in the lake; 7th, 9th, large quantities of floating ice in lake and river. *Maumee River.*—Toledo, 2nd, covered with thin ice; 5th, frozen from shore to shore; 15th, free of ice; 20th, thin ice; 28th, schooner arrived from Cleveland. *Buffalo Creek.*—Buffalo, N. Y., 3rd, frozen over; 18th, ice broke up and passed out; 21st, frozen over; 25th, ice broken up. *Lake Champlain.*—Burlington, 1st, floating ice in lake; 2nd, harbor frozen over. Charlotte, Vt., 2nd, lake freezing over, ice-bridge firm; 6th, crossing ice on foot; 11th, teams crossing; 29th, lake still frozen.

High Tides.—Atlantic City, N. J., 3rd; Sandy Hook, 3rd, carrying away jetty in front of office, and also the track of the N. J. Southern Railroad for several miles, all telegraphic communication interrupted for 24 hours.

TEMPERATURE OF WATER.

The temperature of water as observed in rivers and harbors, with average depths at which the observations were taken, are given in the table on left side of chart No. II. At the following stations observations were not made on the date indicated on account of ice: at Alpena, Duluth, Escanaba and Marquette no observations were made throughout the month; at Buffalo, 3rd to 18th, and 21st to 25th; Burlington, 2nd to 29th; Chicago, 1st, 2nd, 4th to 9th; Cleveland, 3rd; Detroit, 2nd to 11th, 13th to 17th and 19th to 22nd; at Grand Haven, 1st to 21st; New York city, 4th and 5th; Toledo, 5th to 11th. On account of breakage of thermometer no observations were made at San Francisco throughout the month, and at New York City from the 19th to 29th. Observations were commenced at Delaware Breakwater on the 15th.

ATMOSPHERIC ELECTRICITY.

Thunder-storms were reported in the various States and Territories on the following dates: New York, 12th, 18th, 20th, and 26th. South Atlantic States, 2nd, 3rd, 18th, and 19th. In the Gulf States, 12th, 13th, 14th, 18th and 24th. Tennessee and the Ohio valley, 11th, 12th, 13th, 18th and 28th. Upper Lake region, 11th, 12th, 18th, 22nd, 24th, 25th, 26th, 27th and 28th. Missouri, 11th, 12th, 13th, 18th, 24th, 25th and

28th. Iowa, 11th, 24th, 25th and 29th. Indian Territory and Texas, 1st, 11th, 12th, 17th, 18th, 20th, 24th, 25th, 27th, 28th and 29th. California, on the 10th.

Auroras.—Harvard College Observatory, Cambridge, Mass., looked for every clear evening, none seen; 11th, 20th, 29th, evenings, hazy or cloudy. New Corydon, Ind., 8th, 10 p. m.; Muscatine, Ia., 19th, 7 to 10 p. m.; Gardiner, Me., 1st, 29th; Cumberland, Md., 26th; Starkey, N. Y., 6th, 10th, 20th, 27th, 29th; Pembina, 29th; Eastport, 6th, 7th, (29th, 9 to 11:30 auroral arch 20° in height and extending from NNW. to NNE.

Telegraphic communication interferred with by atmospheric electricity.—Ft. Sill, 12th, 24th; Jacksboro, Tex., 24th; Henrietta, Tex., 24th; Mason, Tex., 27th.

OPTICAL PHENOMENA.

Solar Halos observed in the various districts on the following dates: New England, 4th, 5th, 7th, 8th, 19th, 11th, 18th, 20th, 21st, 22nd, 24th, 25th, 27th. Middle Atlantic States, 1st, 2nd, 6th, 9th, 10th, 11th, 17th, 18th, 20th, 24th, 25th, 27th, 29th. South Atlantic States, 7th, 9th, 25th, 27th. 28th. Eastern Gulf States, 7th, 9th, 11th, 27th, 28th. Western Gulf States, 5th, 6th, 19th, 27th. Lower Lake region, 2nd, 3rd, 5th, 6th, 13th, 14th, 15th, 18th, 20th, 21st, 27th. Upper Lake region, 2nd 9th, 11th, 14th, 15th, 16th, 18th, 29th. Ohio valley, 2nd, 12th, 16th, 22nd, 23rd, 24th. Upper Mississippi valley, 2nd. 3rd, 5th, 15th, 16th, 17th, 18th, 22nd, 23rd, 24th, 25th, 26th, 27th, 28th, 29th. Missouri valley, 2nd, 4th, 6th, 10th, 12th, 13th, 14th, 15th, 17th, 20th, 22nd, 24th, 27th, 29th. Rocky Mountains, 6th, 8th, 9th, 10th, 15th, 16th, 17th, 23rd, 27th, 28th. Western Plateau, 8th, 20th, 27th, 28th. California, 8th, 17th, 26th. Oregon, 7th.

Lunar Halos were observed in the various districts on the following dates: New England, 2nd, 20th, 21st, 22nd, 24th, 25th, 27th. Middle Atlantic States, 14th, 16th, 17th, 18th, 20th, 21st, 23rd to 27th. South Atlantic States, 9th, 16th, 17th, 19th, 25th. Eastern Gulf States, 16th, 17th, 18th, 19th, 21st, 23rd to 27th. Western Gulf States, 15th, 17th, 18th, 19th, 20th to 27th, 29th. Lower Lake region, 9th, 12th, 14th, 15th, 16th, 21st, 22nd, 24th. Upper Lake region, 12th, 15th, 16th, 17th, 19th, 20th, 22nd, 25th. Upper Mississippi valley, 14th to 19th, 21st to 29th. Ohio valley and Tennessee, 15th, 16th, 17th, 18th to 25th. Missouri valley, 3rd. 14th, 16th, 17th, 18th, 22nd, 23rd, 24th. Rocky Mountains, 17th, 18th, 19th, 20th, 21st, 22nd. Western Plateau, 17th, 18th, 19th, 21st, 22nd, 25th. California, 25th. Oregon. 18th, 20th.

Mirage.—Oregon, Mo., 9th, 14th; Genoa, Neb., 1st, 2nd, 3rd, 7th, 8th, 29th; Pembina, 5th.

MISCELLANEOUS PHENOMENA.

Sunsets.—The characteristics of the sky at sunset, as indicative of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Service Stations. Reports from 130 stations show 3,745 observations to have been made, of which 32 were reported doubtful; of the remainder 3,110, or 83.8 per cent, were followed by the expected weather.

Meteors.—New Corydon, Ind. 1st, 6th, 7th; Cedar Vale, Kan., 8th; Woodstock, Md., 1st, 16th, 24th, 26th; Fayette, Miss., 13th; Oregon, Mo., 7th, 27th; Waterbury, N. Y., 7th, 14th, 17th; North Volney, N. Y., 28th; Starkey, N. Y., 16th; Boise City, Idaho, 12th, 20th; Madison, Wis., 17th; Rochester, 5th.

Zodiacal Light.—Harvard College Observatory, Cambridge, Mass., looked for every clear evening; distinctly visible on the 2nd, 8th; visible 1st, 4th, 5th, 6th, 7th, 9th; observations on other evenings hindered by moonlight, clouds or haze. Southington, Conn., visible on the 7th and 8th. New Corydon, Ind., on the 1st, 4th, 5th, 7th, 8th 9th, 10th. Muscatine, Iowa, on the 5th and 8th; Cresco, Ia., on the 7th, 8th, 11th, 12th, 29th; Monticello, Ia,, on the 3rd and 9th; Ft. Dodge, Ia., on the 4th and 5th. Cedar Vale, Kan., from the 1st to 9th, 11th, 13th, 14th, 27th, 28th. Somerset, Mass., on the 1st, 4th to 9th, 11th, 27th; Fall River, Mass., on the 1st and 29th. Oregon, Mo., on the 3rd, 5th, 6th, 7th, 8th, 9th, 28th. Austin, Neb., on the 6th. Atco, N. J., on the 1st, 2nd, 3rd, 4th, 6th, 7th, 8th, 9th, 10th, 12th, 16th. Waterburgh, N. Y., on the 1st, 5th, 6th, 7th, 8th, 9th; Starkey, N. Y., on the 25th. Bellefontaine, Ohio, on the 7th, 9th and 19th. Coalville, Utah, on the 3rd and 28th. Wytheville, Va., on the 3rd, 6th and 28th. Woodstock, Vt., seen on clear evenings in the latter part of the month. Lynchburg, Va., on the 3rd, 4th, 6th, 7th. Ft. Whipple, Va., on the 23d. Mr. Ch. Hasselbrink remarks as follows in reference to observations made by him at Havana, Cuba: "February 28th, visible at about 7 p. m.; does not extend more than 30° above the true horizon. The borders or sides of the triangular shape less defined than ever; has at times the appearance of a mass of dust illumined by some source of light; not constant; intensity varies at intervals; real intermittence. The inclination on the horizon is not considerable. The axis approaches the perpendicular and forms with the horizontal line an angle of about 80 degrees; commences vanishing at about 8 p. m. February 29th, not visible; western region cloudy."

Polar Bands.—New Corydon, Ind., 9th, 16th, 20th and 27th; Guttenburg, Ia., 22nd; Yates Center, Kan., 17th; Gardiner, Me., 8th, 21st, 22nd, and 25th; Thornville, Mich., 22nd; Auburn, N. H., 3rd and 27th; Freehold, N. J., 2nd, 12th, and 24th; Vineland, N. J., 28th; Wytheville, Va., 2nd, 6th, 11th and 20th.

Prairie and Forest Fires.—Glenwood, Ia., 23rd; Creswell, Kan., 2nd, 3rd, 5th to 15th, 17th to 29th;

Yates Center, Kan., 18th; Independence, Kans., 4th to 11th, 14th, 17th to 29th; Ft. Sill, 25th; Dodge City, 7th and 9th; Ft. Gibson, 2nd, 4th, 6th, 8th, 9th, 10th, 11th and 22nd; Chattanooga, Tenn., 24th and 25th.

Sun Spots.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent Nautical Almanic Office, Washington, D. C.:

Date—Feb., 1880.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
1st, 10 a. m...	0	5	0	0	0	0	2	14	
2nd, 9 a. m...	0	0	0	0	0	0	2	14	Faculæ.
3rd, 4 p. m	1	3	0	0	1	3	3	11	
4th, 9 a. m...	0	0	0	0	0	0	3	11	Faculæ.
5 p. m...	0	0	0	0	0	0	3	11	
5th, 3 p. m...	0	0	0	0	0	0	3	11	
6th, 3 p. m...	0	0	0	0	0	0	3	11	
7th, 2 p. m...	0	0	0	0	0	0	3	11	
8th, 9 a. m...	0	7	0	0	0	0	3	18*	
9th, 2 p. m...	0	0	0	0	0	0	3	18*	
11th, 3 p. m...	0	0	2	10	0	0	1	8	
14th, 8 a. m	0	0	1	8	0	0	0	0	Several extensive fields of faculæ. Spots probably disappeared by so ar rotation.
21st, 3 p. m...	1	3	0	0	1	3	1	3	
22nd, 11 a. m..	0	3	0	0	0	3	1	6	
23rd, 9 a. m...	0	0	0	0	0	0	1	6	
24th, 8 a. m...	0	0	0	0	0	0	1	3	
4 p. m	0	0	0	0	0	0	1	3	
25th, 9 a. m...	0	3	0	0	0	0	1	6	
26 h, 3 p. m...	0	0	0	0	0	0	1	1	
27th, 2 m.....	0	0	0	0	0	0	1	1	
29th, 12 m.....	1	1	0	0	0	0	2	2	Several broad areas of faculæ.

*Approximated.

Mr. Wm. Dawson, at Spiceland, Ind., reports: "1st, a large group of 12 spots in NE. quadrant, one large spot south of the group; both group and spot 4′ from E. edge; 3rd, 3 groups, 18 spots; one new spot at E. edge; 4th, 3 groups, 8 spots; 5th, 3 groups, 8 spots; 6th, 3 groups, 22 spots; 8th, 4 groups, 15 spots; 10th, 4 groups, 25 spots; 15th, no spots; 20th, one spot very close to edge; 21st, 3 spots near E. edge; 22nd, 3 spots, 1 group; 24th, 6 spots, 1 group; 26th, 1 large spot and 2 little ones near it, nearly S. of centre." Mr. F. Hess, at Ft. Dodge, Ia., reports: 1st, noon, 2 groups in NE. quadrant—upper, 2 large and 10 or 12 small spots and faculæ; lower, 1 large spot and faculæ; 2nd, 9 a. m., same—in all, 3 large and 6 small spots, no faculæ; 3rd, 9 a. m., same, and a large new spot near NE. limb and 1 in SE. quadrant and faculæ; 4th, no sun all day; 5th, 9 a. m., two large and one small spot in NW. quadrant, one large spot in SW. quadrant, one large spot in NE. quadrant and faculæ; 6th, 9 a. m., same four large spots and several small ones—nothing new since yesterday; 7th, 9 a. m., same four large spots nearer to W. limb—nothing new; 8th, 10 a. m., four groups, 3 in NW. quadrant, 1 in SW. quadrant; 9th, 10 a. m., five groups, 4 in NW. quadrant, 1 in SW. quadrant—in all 15 distinct spots and many faculæ; 10th, 10 a. m., same five groups of 15 spots—3 spots very large; 11th, 10 a. m., only 6 spots; first two groups have disappeared by rotation; 12th, 10 a. m., four large and seven small spots and many faculæ in NW. quadrant; 13th, 10 a. m., one large and five small spots, a new group of faculæ near E. limb; 14th, 10 a. m., no spots, but two groups of faculæ near NE. and NW. limbs; 15th to 20th, no spots or faculæ; 21st, noon, one large spot and brilliant faculæ near SE. limb; 22nd, noon, one large spot and 2 distinct smaller ones besides a number of others indistinct; 23rd, noon, one large spot and two smaller ones, no faculæ; 24th, noon, same as on previous day; 25th, no observation made; 26th, 8. a. m., same group near centre E. and W., nothing new; 27th and 28th, no observations; 29th, noon, one large spot in SW. quadrant and a group of faculæ near SE limb.

NOTES AND EXTRACTS.

[*Nature, February* 5, 1880.]

Results of an Inquiry into the Periodicity of Rainfall.—Mr. G. M. Whipple, the author, has collected the following series of rainfall observations, all of which contain more than fifty years' records:

Station.	Periods.	No. of years.	Authority.
Paris	1689–96, 1699–1784, 1773–97, 1814–75	161	Annuaire de l'Observatoire de Montsouris, 1879.
Padua	1725 to 1878	154	MSS. from P. Denza.
England (Symons' table)	1726 to 1865	140	B. A. Report, 1866.
Milan	1764 to 1878	115	MSS. from P. Denza.
London	1813 to 1878	66	Dines and Symons.
Madras	1813 to 1877	65	Nature, vol. xviii, p. 565.
Philadelphia	1810 to 1867	58	Smithsonian Tables, p. 97.
Edinburgh	1822 to 1878	57	Nature, vol. xviii, p. 97.
New Bedford	1814 to 1867	54	Smithsonian Tables, p. 90.
Rome	1825 to 1878	54	MSS. from P. Denza.

To these he added an eleventh, forming a series by combining together the annual rainfall for 1822 to 1875 at London, Paris and Edinburgh, which increased the total number of years of observation to 978.

These he has discussed after a method described at length in the paper, and determined for every series the curves which represent the variation in the means of the amount of annual rainfall for each of the years

comprising the series on the assumption of the presence of a cycle, which he varies in duration from five to fifteen years.

The computed curves are then compared with the actual curves representing the observations, and the number of coincidences and non-coincidences in the epoch of maximum and minimum determined.

The results show that in no one case is there any indication of a period of any integral number of years from five to thirteen inclusive running through them.

It also became evident that for the same epoch the curves of variation differ widely for localities comparatively close together. For example, taking the eleven-year cycle for Padua and Milan, stations only about 130 miles apart, both well situated for observing rain, and no mountain range intervening, the variation curves are as follows:

Year.....	1800 +11n	1801 +11n	1802 +11n	1803 +11n	1804 +11n	1805 +11n	1806 +11n	1807 +11n	1808 +11n	1809 +11n	1810 +11n
Padua.....	−1.3	−0.3	−1.7	+1.1	+4.2	+4.2	−4.9	+3.4	−2.8	−2.8	+1.7
Milan.....	−5.0	+1.5	+0.2	−1.9	−2.5	−0.0	+3.0	+4.7	−5.6	+2.6	+3.3

These show that the years of greatest rainfall at Padua are represented by the formula [1804 or 5 + 11n], and of least by [1806 + 11n], whilst for Milan the maximum occurs at [1807 + 11n], and the minimum at [1808 + 11n].

Numerous other instances of incongruity are found in every one of the cycles, leading forcibly to the conclusion that either no short term of exactly five, six, seven, eight, nine, ten, eleven, twelve, or thirteen years exists in the annual amount of rainfall at any of the stations whose observations have been discussed in the paper, or that the effect of abnormal falls is so great that it cannot be eliminated by upwards of a hundred years' observations.

In any case the author thinks it may now be stated with certainty that all predictions as to rainy or dry years, based upon existing materials, must in future be considered as utterly valueless.

Movements of Storms.—In his twelfth contribution to Meteorology Prof. Elias Loomis writes as follows:

Rate of progress of barometric minima.—Dr. Neumayer has given for each month in the years 1876 and 1877 the average daily progress of barometric minima in Europe expressed in myriameters. I have reduced these values to English miles per hour, and the results are shown in column 4th of the following table. For the purpose of comparison, I have placed in column 2nd the velocities deduced from three years observations in the United States as published in this Journal, vol. x, p. 1. I have also reduced to a tabular form the velocities given in the monthly reports of the Signal Service since November, 1875,

	Loomis.	Sig. Ser.	Europe.		Loomis.	Sig. Ser.	Europe.
January.....	26.7	33.3	15.8	July.....	24.9	27.6	14.7
February.....	32.0	28.5	14.0	August.....	18.4	22.8	14.5
March.....	30.5	30.2	18.2	September.....	22.9	21.5	15.0
April.....	27.5	24.1	14.9	October.....	25.8	21.4	19.7
May.....	23.5	23.6	12.7	November.....	29.0	25.5	15.8
June.....	21.6	23.5	14.5	December.....	29.3	34.0	15.8
				Year.....	26.0	26.3	15.5

and have determined the averages for each month. These results are shown in column 3rd of the table. They are derived from forty-four months of observation, and refer to the region between the Atlantic Ocean and the meridian of 100° from Greenwich.

The average velocity of storm-centres in the United States is seen to be 69 per cent. greater than it is in Europe. In my tenth paper (this Jour., vol. xvii, p. 3) I determined the average velocity of storm-centres on the Atlantic Ocean to be 14 miles per hour, which is somewhat less than the value above found for the continent of Europe.

It appears then to be an established fact that storms travel more rapidly over the eastern portion of the United States than they do over the Atlantic Ocean or the continent of Europe. What cause can be assigned for this inequality? The winds on the Atlantic Ocean are certainly stronger than they are over either of the continents, and it is believed that the winds of Central Europe are generally stronger than the winds of the United States. * * * In my first paper (this Jour., vol. viii, p. 7) from a comparison of a large number of cases, I showed that generally the stronger the wind on the west side of a storm the less the velocity of the storm's progress. If the more rapid progress of storm-centres in the United States results from a difference in the velocity of winds it seems probable that the effect is produced by means of the vapor which is precipitated. From the Rocky Mountains to the Atlantic Ocean storms advance from a dryer to a more humid atmosphere. In Europe, while storms travel eastward, they advance from a humid to a dryer atmosphere. Upon the Atlantic Ocean the vapor on the western side of storm-centres generally has a greater tension than it has upon the eastern side, owing to the warm water of the Gulf Stream. In my eighth paper (this Jour., vol. xv, p. 11) I have shown that in the vicinity of Newfoundland storms are frequently delayed several days, and this result is apparently due to the abundant precipitation of vapor in that region. In my first paper (this Jour., vol. viii, p. 6) I have shown that when a storm-centre advances

eastward most rapidly, the rain-area generally extends to an unusual distance on the east side; and the storm-centre advances less rapidly than usual when the rain-area extends but little on the east side. These facts seem to indicate that in Europe the center of rain-area must precede the center of least pressure by a less distance than it does in the United States. I have endeavored to decide this question by a comparison of observations. * * * * *

From these observations we must conclude that storms may travel eastward even though the center of the rain-area is somewhat west of the center of low pressure. In my tenth paper (this Jour., xvii, p. 12) I have shown that the change of wind which accompanies a barometric minimum generally begins at the surface of the earth, before it does at elevated stations, indicating that the west wind in the rear of the storm pushes under the east wind, lifting it from the surface of the earth, so that a change of wind and an increase of barometric pressure is observed at the surface before there is any change of wind at the elevation of 2,000 or 3,000 feet. This movement of the winds does not prevent the storm-centre from advancing eastward, but the storm advances less rapidly than when the centre of the rain-fall is considerably east of the centre of low pressure, as is generally the case in the United States.

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Albert J. Myer

Brig. Gen. (Bvt. Assg^d.,) Chief Signal Officer, U. S. A.

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VIII. 60 do.
IX. 37 do.
X. 24 do.
XI. 37 do.
XII. 40 do.
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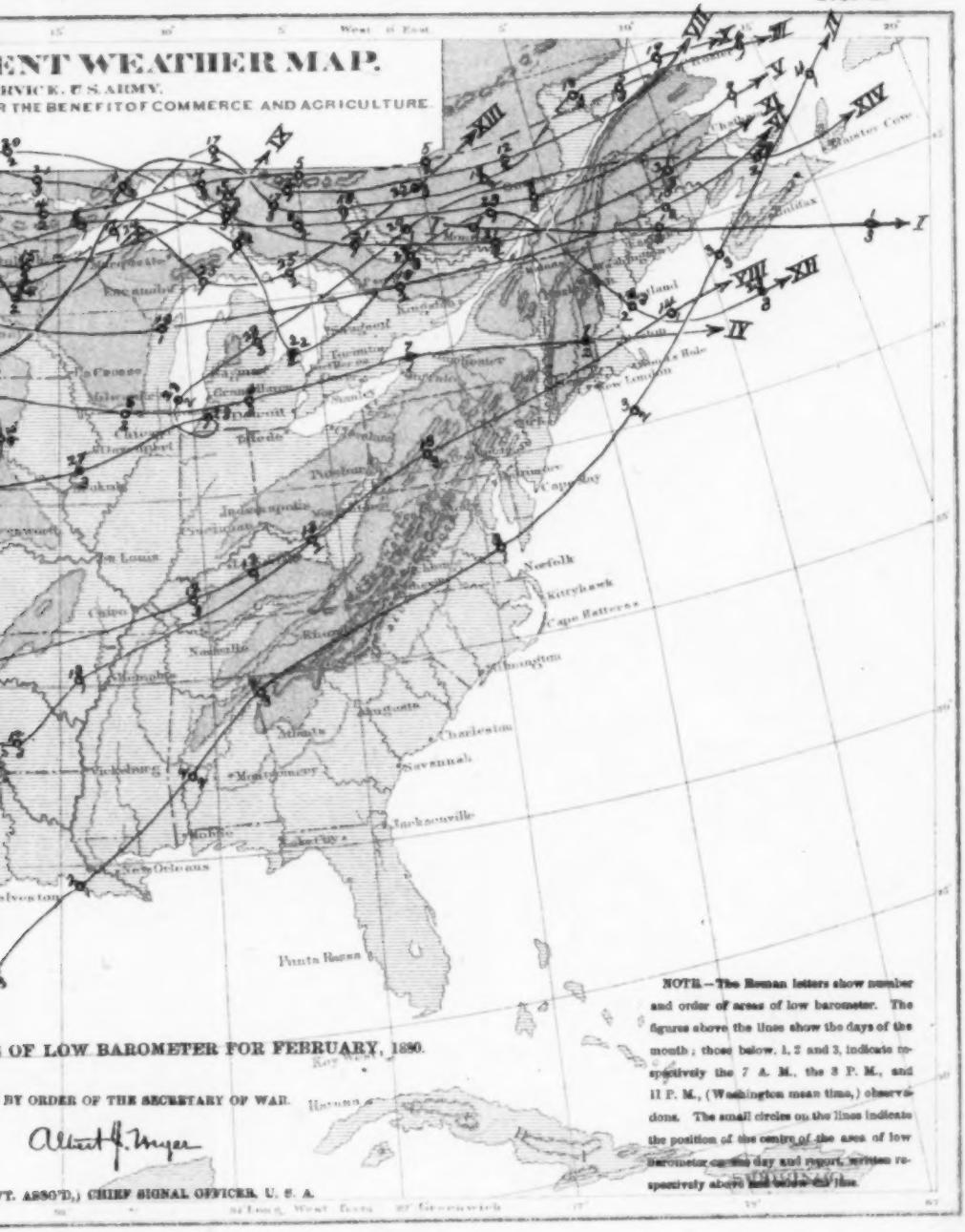
BRIG. GEN., (EVT. ASS

No. I.



OF LOW BAROMETER FOR FEBRUARY, 1880.

BY ORDER OF THE SECRETARY OF WAR.

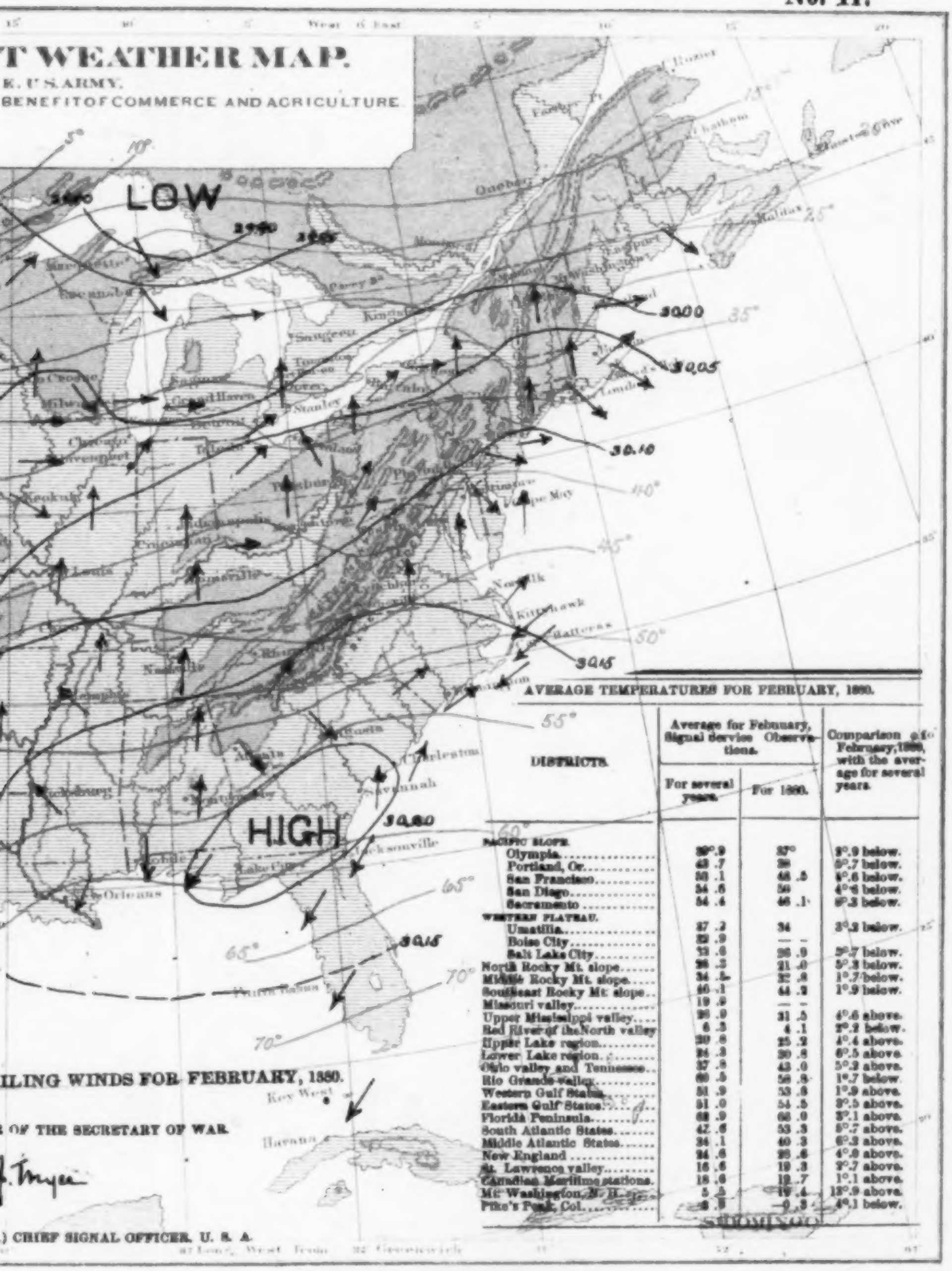
Albert J. Myer

T. ASSO'D.,) CHIEF SIGNAL OFFICER, U. S. A.

TEMPERATURE OF WATER FOR FEBRUARY, 188[illegible].

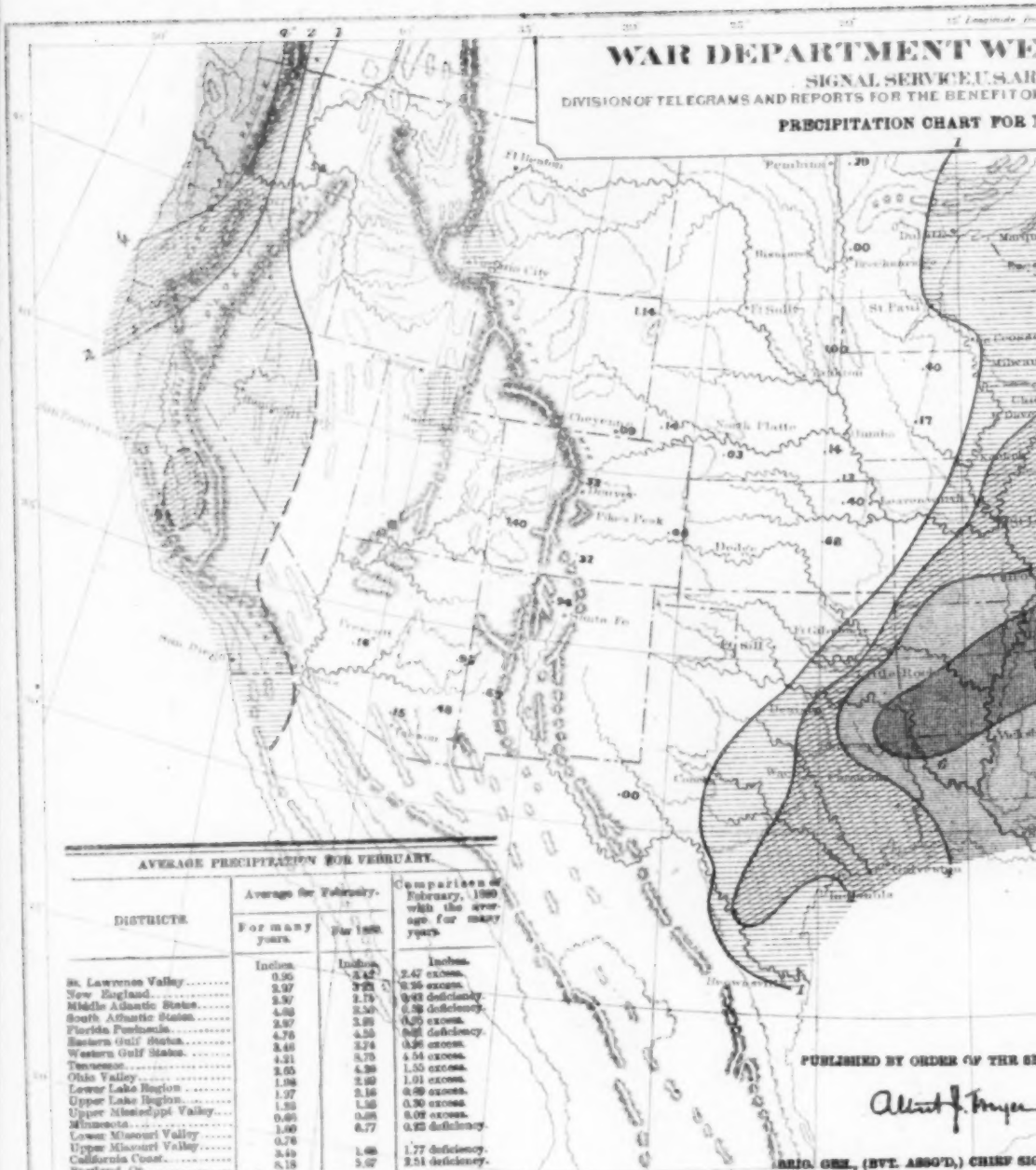
STATIONS.	Temperatures at bottom. Max.	Temperatures at bottom. Min.	Average depth of water, in feet.
*Alpena	—	—	—
Augusta	61°	43°	8.9
Baltimore	44	37	[illegible]
*Buffalo	43	33	[illegible]
*Burlington, Vt.	—	—	—
Cedar Keys	72.5	54	12.5
Charleston	59	53	45
*Chicago	39	33	6
*Cleveland	41	39	14
*Detroit	35	33	24.5
*Duluth	—	—	—
*Del. Breakwater	46	40	6.4
Eastport	36	33	19.7
*Escanaba	—	—	—
Galveston	66.5	51	14
*Grand Haven	43	36	15
Jacksonville	67	57	10
Key West	77	73	18
*Marquette	—	—	—
Milwaukee	38	32	8
Mobile	60	50	15
New London	40	35.5	12.4
*New York	37	34	22.5
Norfolk	56	41	22
Portland, Maine	33	32	26
Punta Rassa	—	—	—
Sandusky	—	—	—
*San Francisco	—	—	—
Savannah	61	49	9.6
*Toledo	44	33	14.5
Wilmington	60	50	11.6
Wood's Holl	39	35	8

* Observations for only part of month—See text.



AVERAGE TEMPERATURES FOR FEBRUARY, 1880.

DISTRICTS.	Average for February, Signal Service Observations. For several years.	Average for February, Signal Service Observations. For 1880.	Comparison of February, 1880, with the average for several years.
PACIFIC SLOPE.			
Olympia	39°.9	37°	2°.9 below.
Portland, Or.	43 .7	38	5°.7 below.
San Francisco	50 .1	46 .5	4°.6 below.
San Diego	54 .6	50	4°.6 below.
Sacramento	54 .4	46 .1	8°.3 below.
WESTERN PLATEAU.			
Umatilla	37 .2	34	3°.2 below.
Boise City	32 .9	— —	
Salt Lake City	33 .6	26 .9	5°.7 below.
North Rocky Mt. slope	26 .3	21 .0	5°.3 below.
Middle Rocky Mt. slope	34 .5	32 .8	1°.7 below.
Southeast Rocky Mt. slope	46 .1	44 .2	1°.9 below.
Missouri valley	19 .6	— —	
Upper Mississippi valley	26 .9	31 .5	4°.6 above.
Red River of the North valley	6 .3	4 .1	2°.2 below.
Upper Lake region	20 .8	25 .2	4°.4 above.
Lower Lake region	24 .3	30 .8	6°.5 above.
Ohio valley and Tennessee	37 .8	43 .0	5°.2 above.
Rio Grande valley	60 .5	58 .8	1°.7 below.
Western Gulf States	51 .9	53 .8	1°.9 above.
Eastern Gulf States	51 .0	54 .5	3°.5 above.
Florida Peninsula	62 .9	66 .0	3°.1 above.
South Atlantic States	42 .6	53 .3	5°.7 above.
Middle Atlantic States	34 .1	40 .3	6°.2 above.
New England	24 .6	28 .6	4°.0 above.
St. Lawrence valley	16 .6	19 .3	2°.7 above.
Canadian Maritime stations	18 .6	19 .7	1°.1 above.
Mt. Washington, N. H.	5 .5	19 .4	13°.9 above.
Pike's Peak, Col.	3 .8	—0 .3	4°.1 below.



AVERAGE PRECIPITATION FOR FEBRUARY.

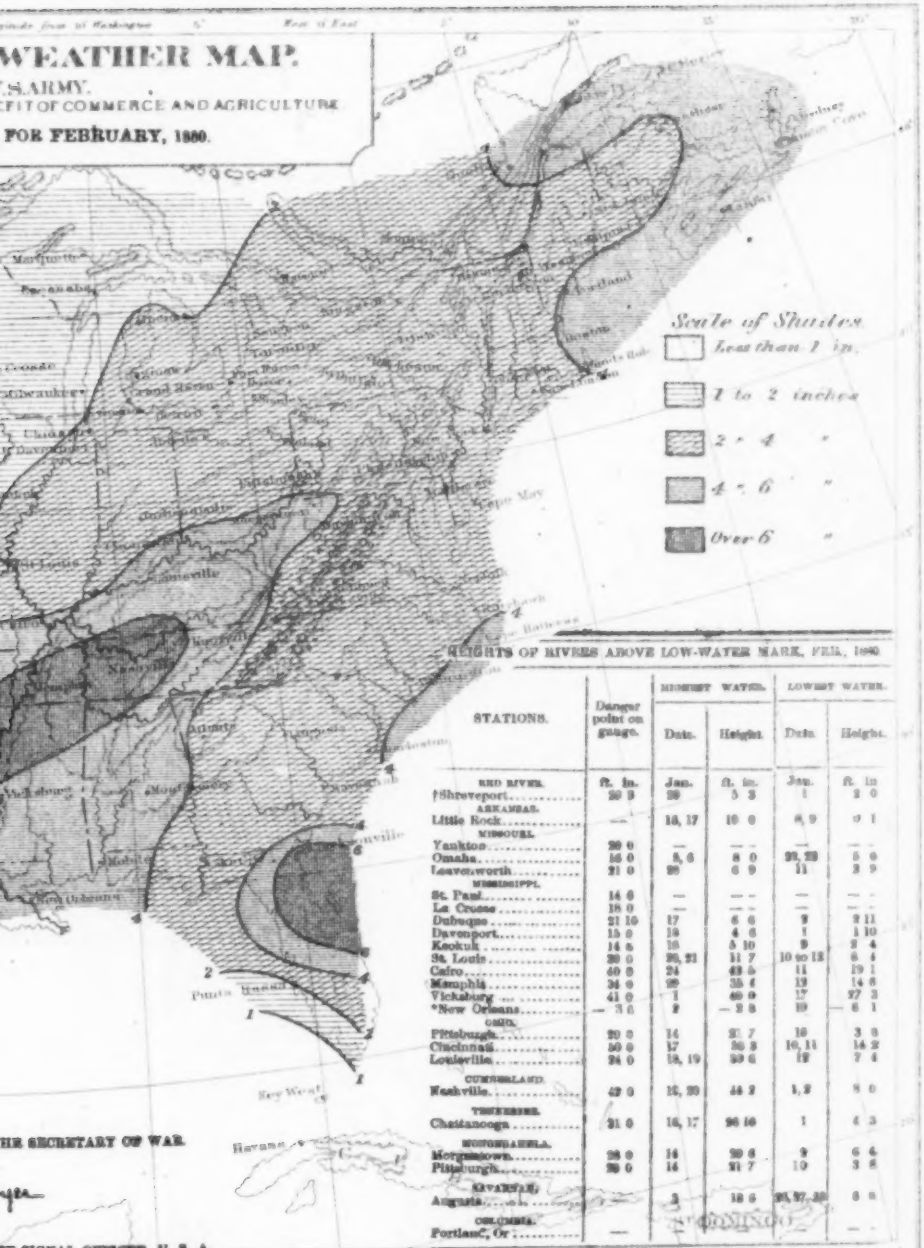
DISTRICTS.	Average for February.		Comparison of February, 1880 with the average for many years.
	For many years.	For 1880.	
	Inches.	Inches.	Inches.
St. Lawrence Valley	0.95	3.42	2.47 excess.
New England	2.97	3.23	0.26 excess.
Middle Atlantic States	2.97	2.78	0.93 deficiency.
South Atlantic States	4.03	3.50	0.53 deficiency.
Florida Peninsula	2.97	3.89	0.92 excess.
Eastern Gulf States	4.76	4.59	0.17 deficiency.
Western Gulf States	3.40	3.74	0.34 excess.
Tennessee	4.21	5.76	1.54 excess.
Ohio Valley	2.55	4.30	1.55 excess.
Lower Lake Region	1.08	2.09	1.01 excess.
Upper Lake Region	1.27	2.16	0.89 excess.
Upper Mississippi Valley	1.23	1.53	0.30 excess.
Minnesota	0.60	0.68	0.07 excess.
Lower Missouri Valley	1.60	0.77	0.83 deficiency.
Upper Missouri Valley	0.76		
California Coast	3.49	1.68	1.77 deficiency.
Portland, Or.	8.18	5.67	2.51 deficiency.

WEATHER MAP.

U.S. ARMY.

DEPT OF COMMERCE AND AGRICULTURE

FOR FEBRUARY, 1880.



HEIGHTS OF RIVERS ABOVE LOW-WATER MARK, FEB., 1880.

STATIONS.	Danger point on gauge.	HIGHEST WATER. Date.	HIGHEST WATER. Height.	LOWEST WATER. Date.	LOWEST WATER. Height.
RED RIVER.	ft. in.	Jan.	ft. in.	Jan.	ft. in.
†Shreveport	30 9	29	5 3	1	2 0
ARKANSAS.					
Little Rock	—	16, 17	10 0	8, 9	0 1
MISSOURI.					
Yankton	20 0	—	— —	—	— —
Omaha	16 0	5, 6	8 0	20, 23	5 0
Leavenworth	21 0	28	6 9	11	3 9
MISSISSIPPI.					
St. Paul	14 0	—	— —	—	— —
La Crosse	18 0	—	— —	—	— —
Dubuque	21 10	17	6 6	2	2 11
Davenport	15 0	18	4 6	1	1 10
Keokuk	14 6	16	5 10	9	2 4
St. Louis	30 0	20, 21	11 7	10 to 13	6 4
Cairo	40 0	24	43 5	11	19 1
Memphis	34 0	29	35 4	13	14 6
Vicksburg	41 0	1	46 0	17	27 3
*New Orleans	— 3 0	2	— 2 8	19	— 6 1
OHIO.					
Pittsburgh	22 0	14	21 7	16	3 8
Cincinnati	50 0	17	36 3	10, 11	14 2
Louisville	24 0	18, 19	33 6	12	7 4
CUMBERLAND.					
Nashville	42 0	15, 20	44 2	1, 2	8 0
TENNESSEE.					
Chattanooga	21 0	16, 17	26 10	1	4 3
MONONGAHELA.					
Morgantown	28 0	14	30 6	2	6 6
Pittsburgh	30 0	14	21 7	19	3 8
KANAWHA.					
Augusta	—	3	18 6	20, 27, 29	8 6
COLUMBIA.					
Portland, Or	—	—	— —	—	— —

*Below high water mark of 1874. † Above low water mark of 1878.

THE SECRETARY OF WAR.

CHIEF SIGNAL OFFICER, U. S. A.

CHART No. IV.

INDEX TO STORM-TRACKS

Atlantic Ocean.

No. I. from Jan. 27, 1879 to Jan. 4, 1880.
II. from Dec. 31, 1879 to Jan. 5, 1880.
III. from Dec. 31, 1879, to Jan. 4, 1880.
IV. from Jan. 2, 1880, to Jan. 10, 1880.
V. from Jan. 12, 1880, to Jan. 24, 1880.
VI. from Jan. 18, 1880, to Jan. 20, 1880.
VII. from Jan. 22, 1880, to Jan. 27, 1880.

Pacific Ocean.

VIII. on November 28th, 1879.

WINDS ACCOMPANYING THE ATLANTIC STORMS.

No.	*American Coast.* Date	Direction.	Miles per Hour.	Miles per second.	*European Coast.* Date	Direction.	Miles per Hour.	Miles per second.
I.	Dec. 29	S.	40	17.9	Jan. 9	WSW.	*70	*31.3
IV.	Jan. 4	W.	40	17.9	9	SW.	*50	*22.3
VII.	"	W.	35	15.6	25	SE.	*72	*31.8

* Estimated from A scale of 0 to 9.

INTERNATIONAL METEOROLOGY—OCEAN STORM-TRACKS.

Broken or dotted lines indicate that the lines so broken are doubtful.

Arrows, when charted, fly with the wind and exhibit wind-direction.

The tracks charted in black have appeared in previous *Reviews*.

The tracks charted in red have been made from data collected since preceding *Review*.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

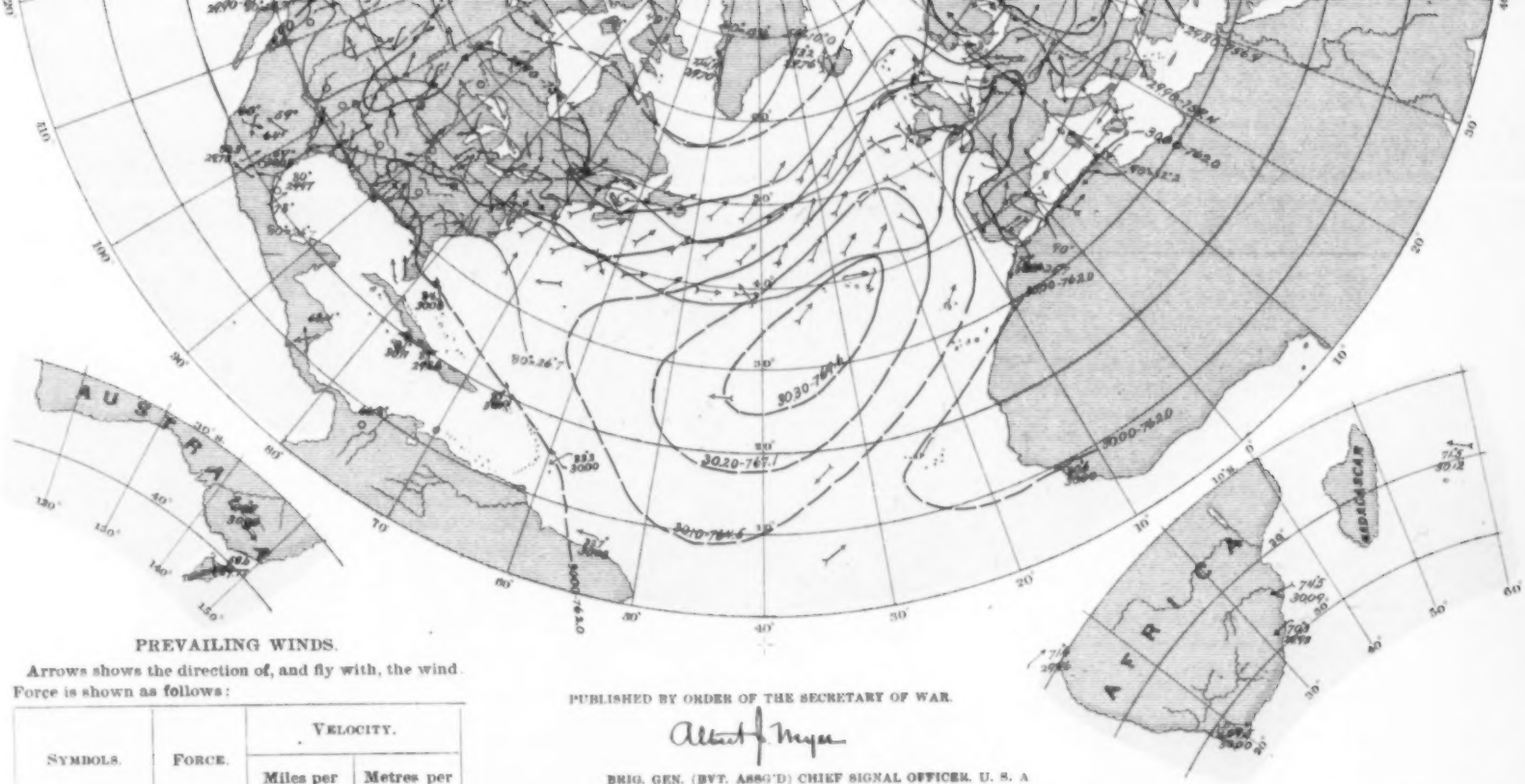
BRIG. GEN. (BVT. ASSG'D) CHIEF SIGNAL OFFICER U. S. A.

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously, Series commencing October, 1877.

No. V.



PREVAILING WINDS.

Arrows shows the direction of, and fly with, the wind. Force is shown as follows:

Symbols.	Force.	Velocity.	
		Miles per hour.	Metres per second.
→	1, 2	0 to 9	0 to 4.0
→	3, 4	9.1 to 22.5	4.1 to 10.1
→	5, 6	22.6 to 40.5	10.1 to 18.1
→	7, 8	40.6 to 67.5	18.1 to 30.2
→	9, 10	67.6 up.	30.2 & over.

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BRIG. GEN. (BVT. ASS'T) CHIEF SIGNAL OFFICER, U. S. A.

ISOBARS AND ISOTHERMS.

Isobars in *blue*; detached barometer means in English inches.

Isotherms in *red*; detached temperature means in degrees Fahrenheit.

INTERNATIONAL MONTHLY CHART.

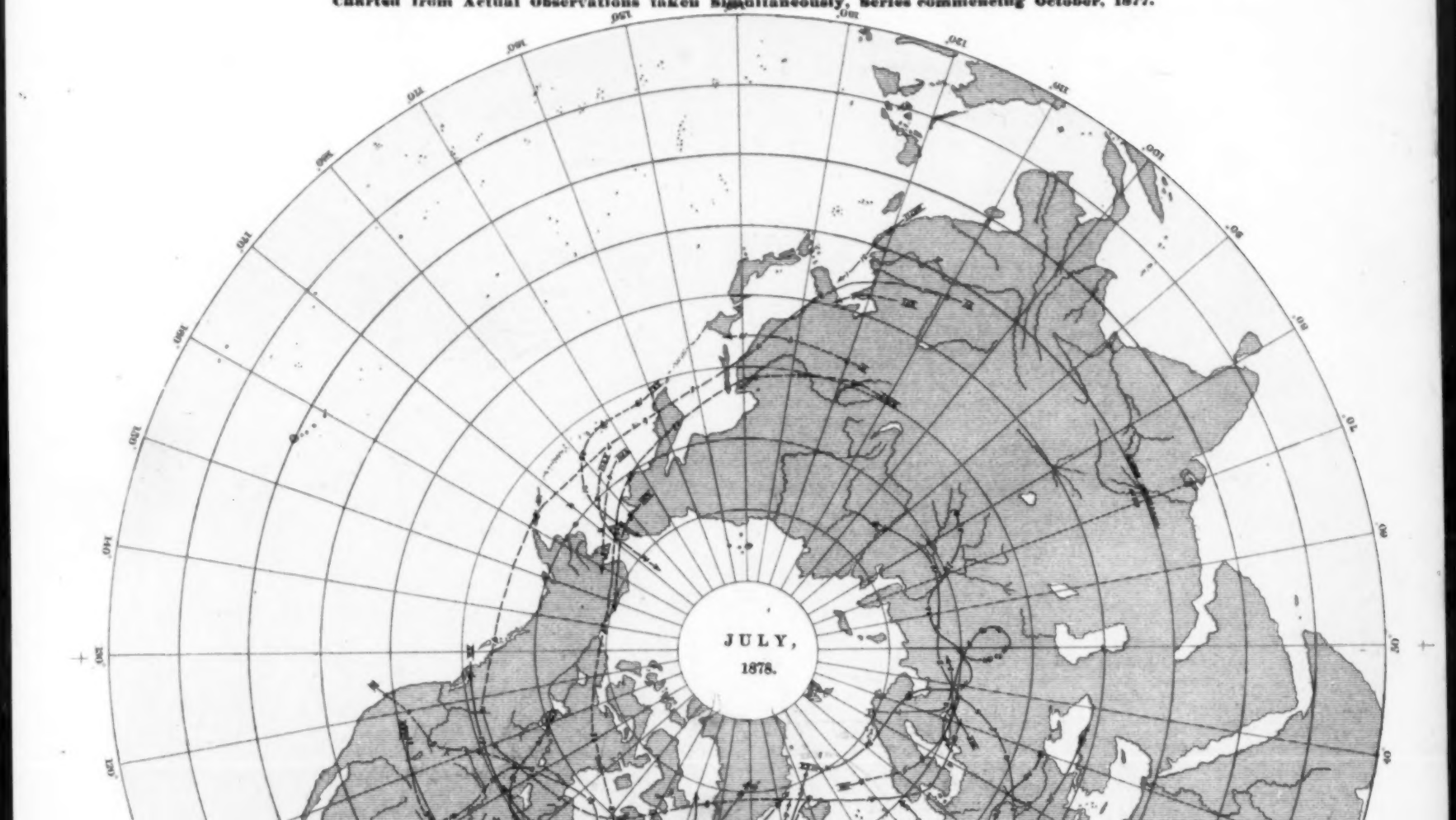
Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of July, 1878, based on the daily charts of the International Bulletin.

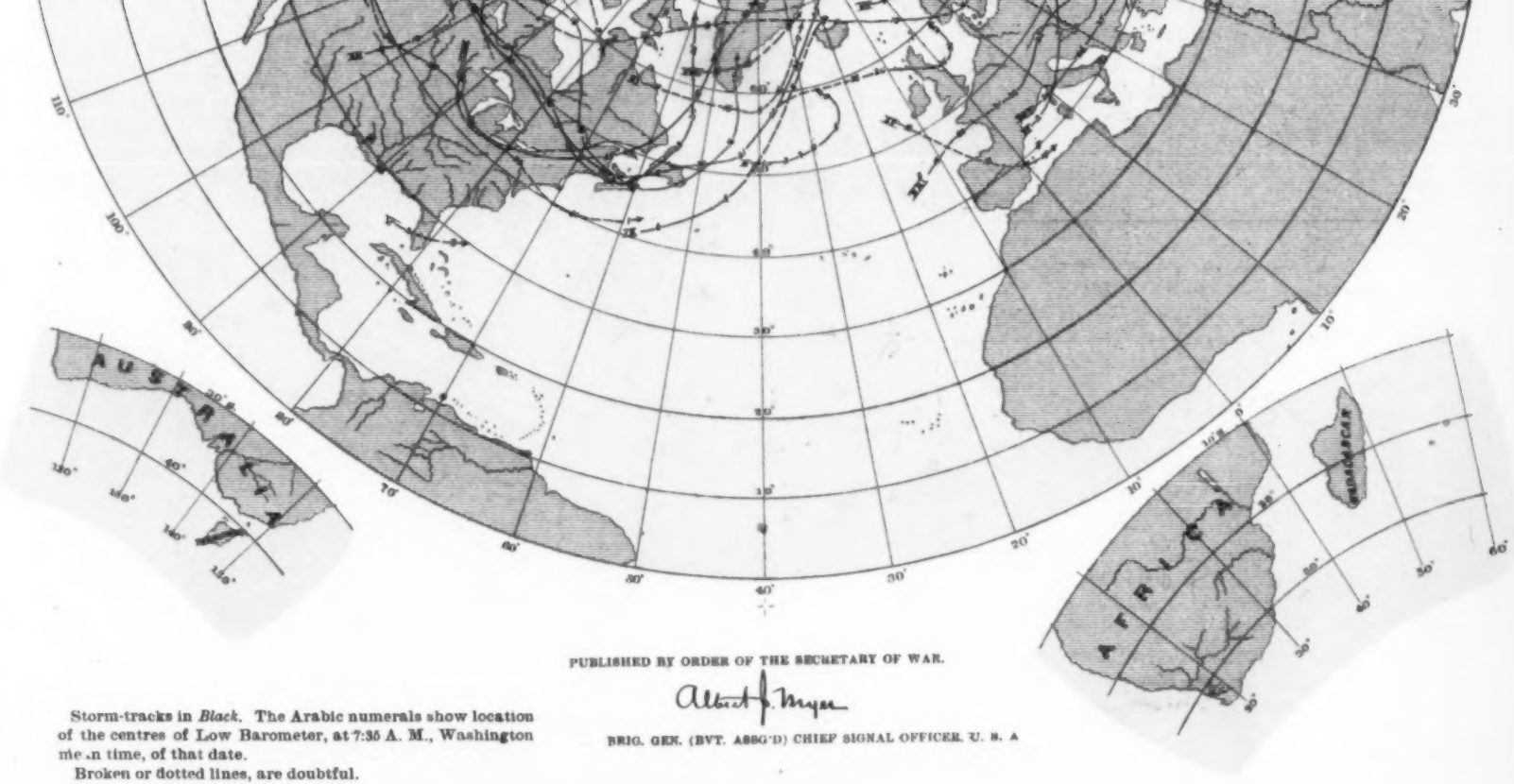
Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously, Series commencing October, 1877.

No. VI.





Storm-tracks in *Black*. The Arabic numerals show location of the centres of Low Barometer, at 7:35 A. M., Washington mean time, of that date.

Broken or dotted lines, are doubtful.

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Albert J. Myer

BRIG. GEN. (BVT. ASSG'D) CHIEF SIGNAL OFFICER. U. S. A

INTERNATIONAL CHART.

Showing Tracks of Centres of Low Barometer for July, 1878.